The Electrical Industry's Weekly Magazine

October 2, 1961

Electrical World

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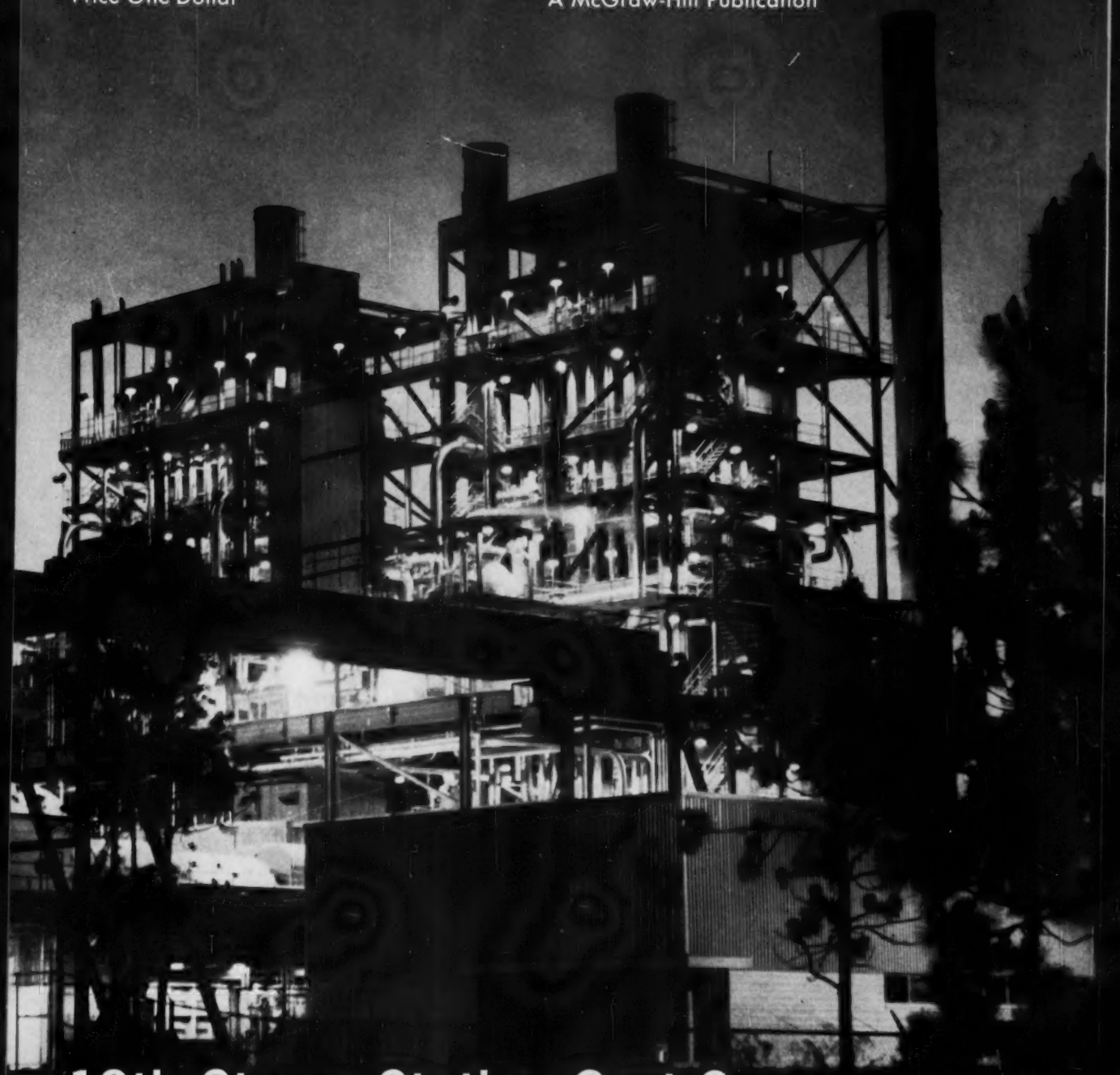

12th Steam Station Cost Survey ...page 69

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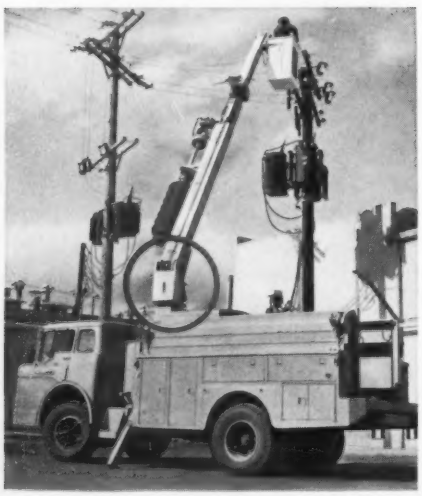

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Electrical World

October 2, 1961
Vol. 156, No. 14

Dateline . . .

Where Does Preference Stand After Delaware Hassle?

Washington, D. C.—Efforts by public power advocates to include a preference clause in the Delaware River Compact legislation "came a cropper" in each attempt before Congress this year.

The question arises, however, whether the defeat was significant, and, if it wasn't, why the fight on the part of public power?

The burden of the public power arguments for inclusion of preference appears to be that: **(1)** The conspicuous absence of the clause might be interpreted at a later time that Congress had favored a shift in power policy; **(2)** The wording of Article 9 of the compact (dealing with power development) actually would work to the detriment of the municipal and co-op systems in the Delaware basin.

Interior Secretary Udall also got in to the fray, testifying, "I strongly recommend that this major public policy be continued in the present bill."

The National Rural Electric Co-op Assn testified that, without preference, the measure would be a "complete repudiation and abandonment of existing federal policy."

General Manager Alex Radin of the American Public Power Assn added that "omission of the preference clause has the practical effect of handing over Delaware hydropower to the private power companies, and of preventing the small municipal and rural electric co-ops from even having the opportunity of purchasing this publicly-generated power."

Surprisingly, however, those who turned down the preference pleas emphasized they were not voting against preference as a principle. Said Sen Joe Clark (D-Pa.), "I, personally, am for public power and the preference clause . . . but . . . there is no need to write a preference clause into the federal enacting legislation approving this compact at this time." And Pennsylvania Gov David Lawrence testified, "General federal laws, undisturbed by the compact, can be depended upon to maintain established federal laws"—such as preference.

These, and other statements, form a legislative history which proponents will rely upon to support

(*Continued on page 5*)

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Whether you're using the "open type" Bulletin 705 reversing starters in special panel mounting or as an enclosed device for mounting on a machine, the space you can save will surprise you—especially in the higher ratings! For instance, the open type construction is appreciably narrower than the older design. In the enclosed design—because the overload relays (either 2 or 3) are mounted as a "block" below the reversing switch, the cabinet is much narrower.

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QUALITY MOTOR CONTROL

Dateline . . .

Washington, D. C. (*Continued from page 3*)
preference, if and when the issue arises properly.

What they were saying is that the compact bill is only an authorizing bill—not a project bill; and preference would become an issue only when federal funds were to be requested to build all or part of a compact project. The Senate Public Works Committee put it this way: "The committee sees no reason to place further restrictions on the commission at this time in the form of a mandate that the preference provisions would be applicable to all projects whether state or federally financed."

There is a general feeling in Congress also that federal preference might be involved in a compact project to the same percentage of federal aid. A 20% federal obligation in a Delaware project might call for 20% of the power to be sold under federal preference laws.

Both the Senate and House Judiciary Committees emphasized that "existing preference clauses . . . governing projects financed with federal funds would continue to apply to any projects authorized . . . by contrast, if the preference clause were to be written into the present compact bill, the Congress would be asking the four states . . . to subscribe to it, even as to projects which may be financed solely out of state funds."

There is still another question raised, concerning the legality of federal preference. The Senate Interior Committee pointed this out: "We are not here considering a TVA area . . . The Delaware River basin is already covered by a grid of marketing facilities . . . It is at least questionable whether the public interest is best served by duplicating transmission facilities . . . It is also questionable whether federal policy which has been developed to encourage the electrification of areas lacking proper service is actually applicable under the highly urbanized condition of the Delaware River basin."

Letters

An Extension of Remarks on REA

To the Editor:

In your report on the American Institute of Cooperation annual meeting published Sept 4 in *Electrical World*, you have failed to quote me entirely correctly in several instances.

My statement on the dual-rate clause was that "the benefits of the RAD (Rural Area Development) program" would be denied to the areas served by the Rural Electrification Administration electric cooperatives who purchase power under dual rate contracts. I said nothing about RAD funds, but only that a cooperative which has no competitive source of power for small industry cannot be expected to attract or develop small rural industry.

In my panel discussion I stated that the new Power Division of REA would examine G&T (generation and transmission) plans and applications to determine which were good and necessary. In answer to later questions I stated that total G&T applications greatly exceeded available funds but that REA made no loans for G&T without careful screening of applications for compliance with REA criteria.

I was then asked if there was not a strong probability that REA would be short of funds assuming that all of the loan applications on hand turned out to be good and necessary. I replied that under such an assumption "it is a fact" that we would be short of funds. However, it is also a fact that we do expect to have sufficient funds this fiscal year to meet nearly all requirements for needed and justified G&T loans.

Richard H. Wood
Assistant Administrator
Rural Electrification Administration

▶With reference to locating small industry in rural areas, we would point out that many other factors would probably be taken into consideration other than the cost of power.

This is your column in Electrical World. Address correspondence to Letters Editor, Electrical World, 330 W. 42nd Street, New York 36, N. Y.

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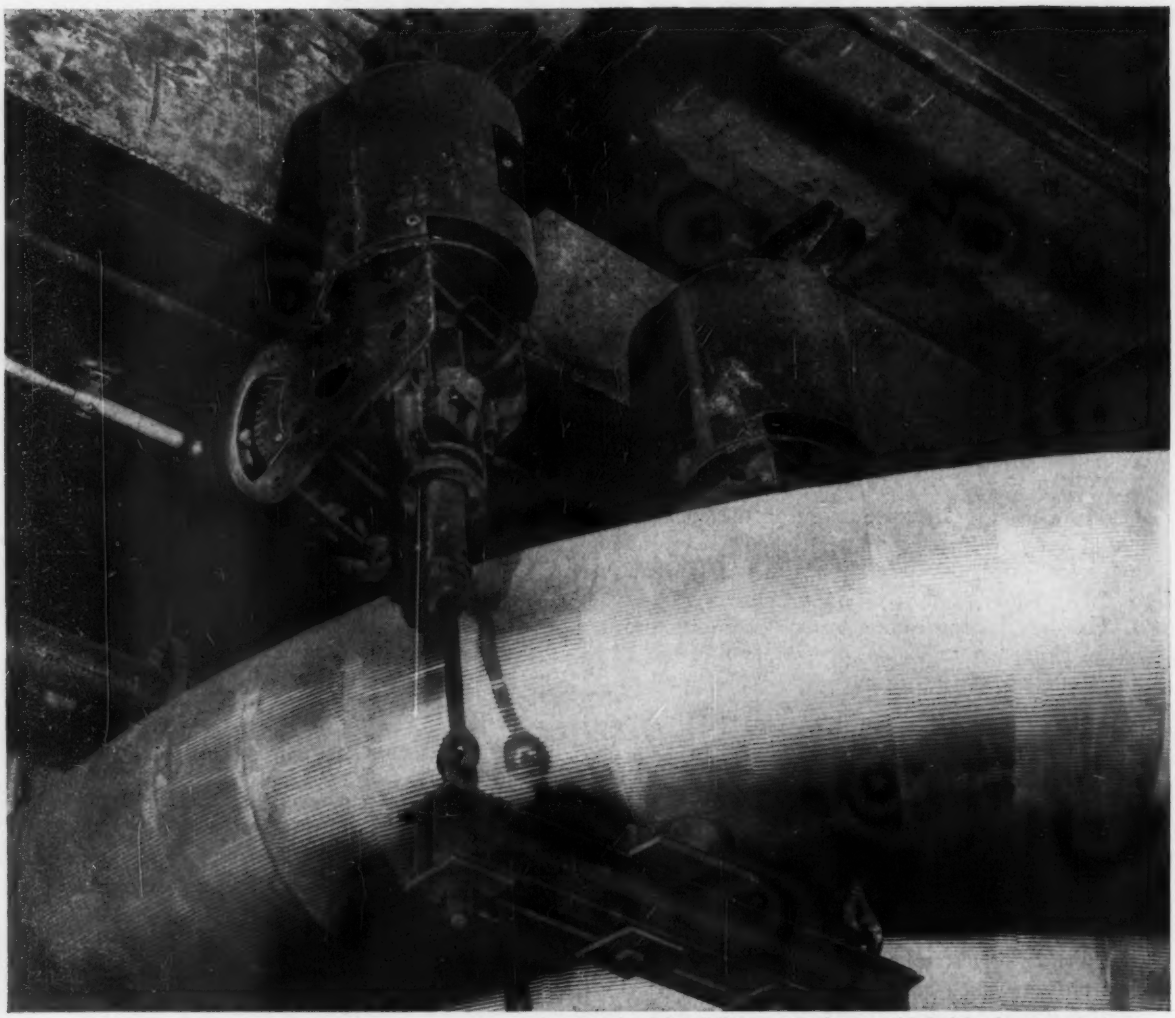

Space-saving Grinnell Hangers snugly support hot piping in cramped places.

Hot-to-handle piping . . . little space to spare . . . both problems solved with Grinnell Pipe Hangers

Grinnell Hanger assemblies support feedwater piping at 500,000-kw. power station

American Electric Power Company's 500,000-kw Philip Sporn Station, Unit No. 5 at New Haven, West Va., is one of America's largest power stations. The feedwater piping from the heater to the steam generator presented especially difficult heat and space problems for pipe supports — problems solved by Grinnell Pipe Hangers.

The 14-inch feedwater piping — with walls 1-13/16 inches thick — heats up to 560°F . . . takes pressures up to 4860 PSI. What's more, the piping runs unusually close to ceilings and beams!

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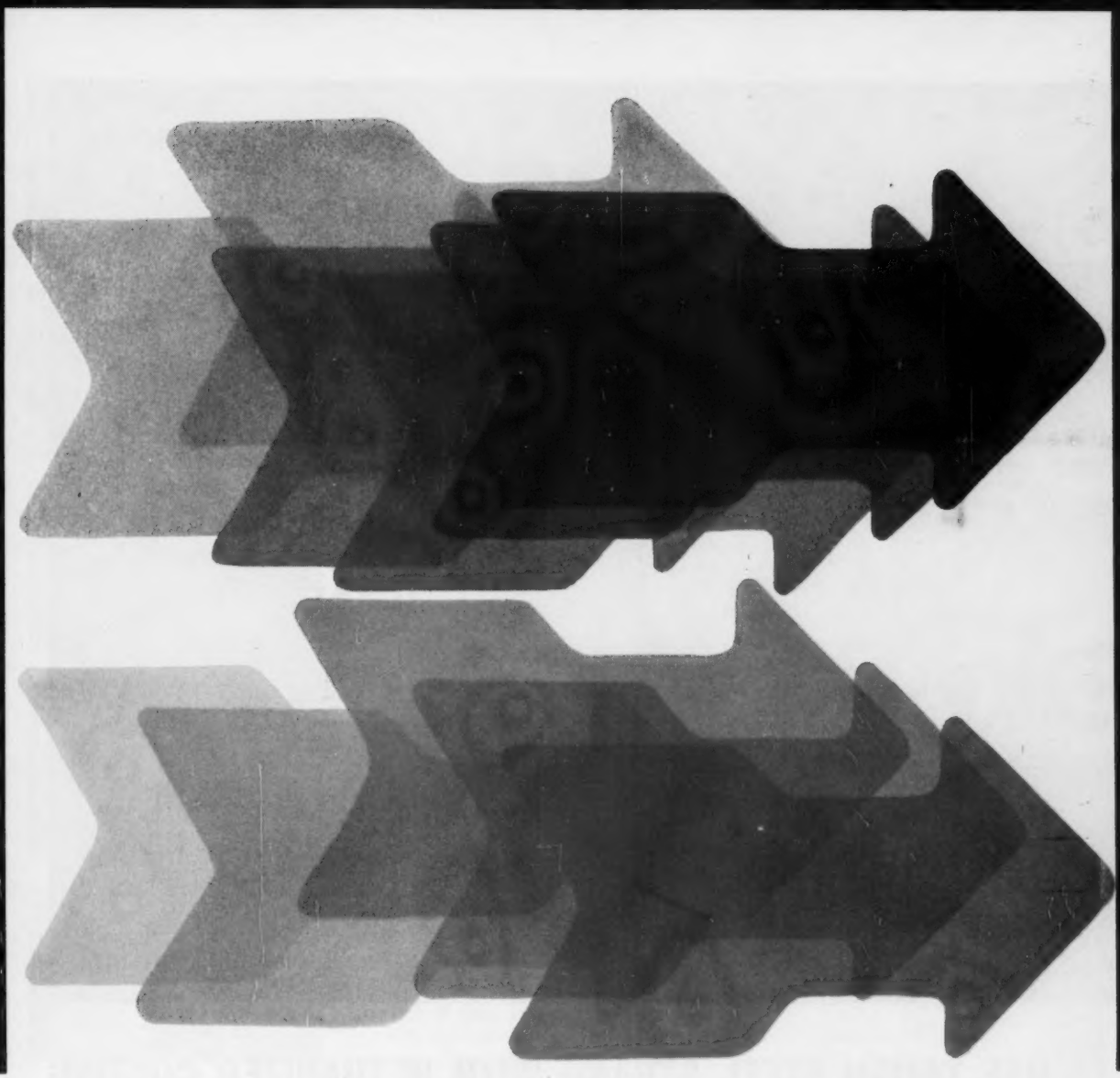

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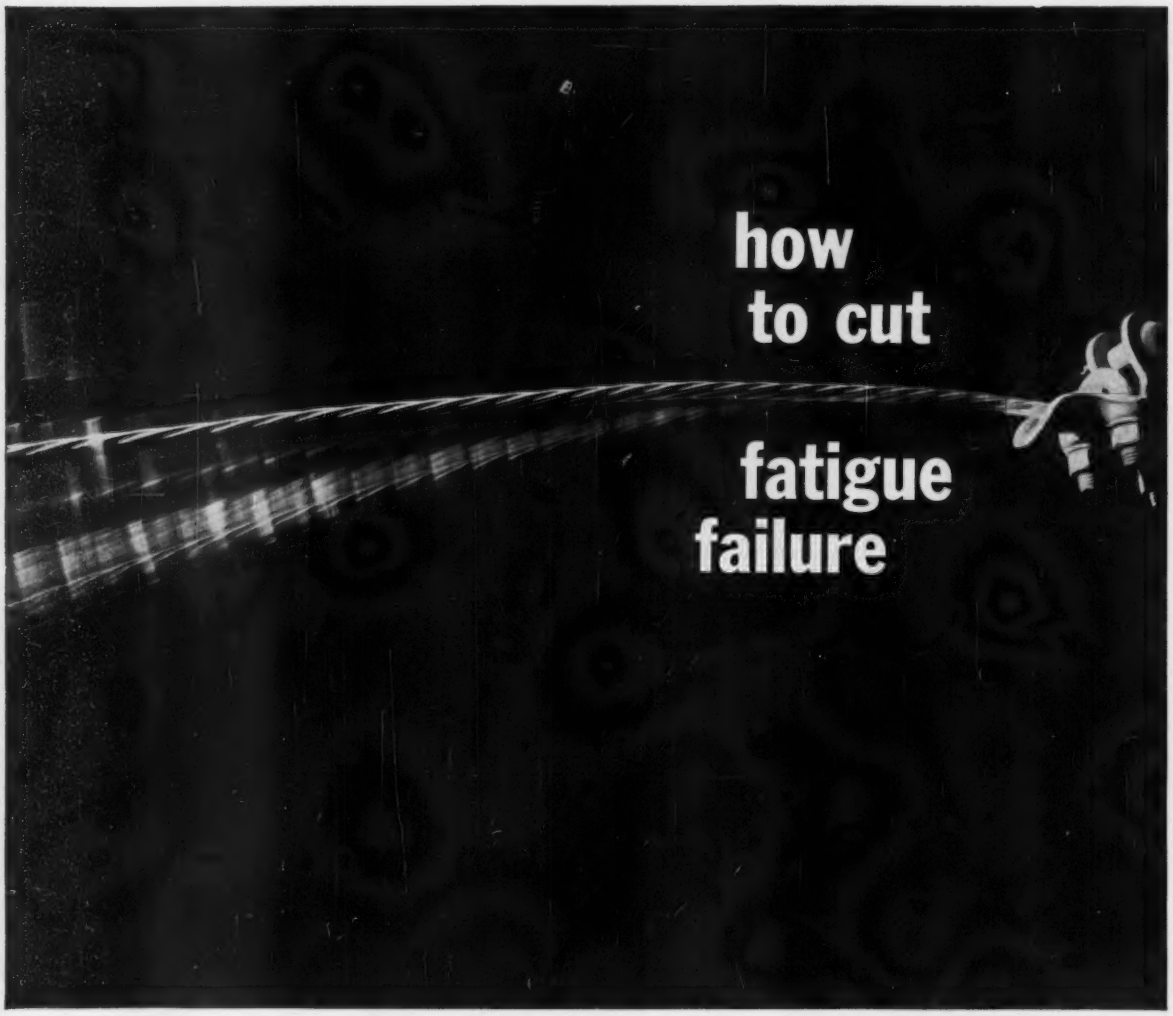

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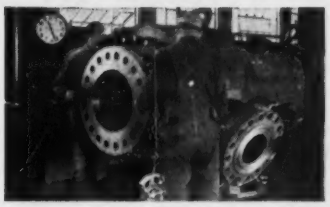
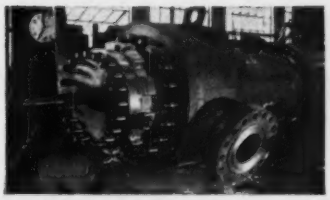
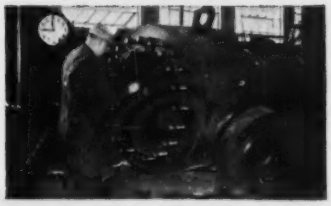
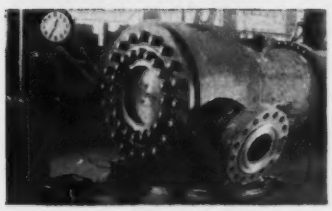
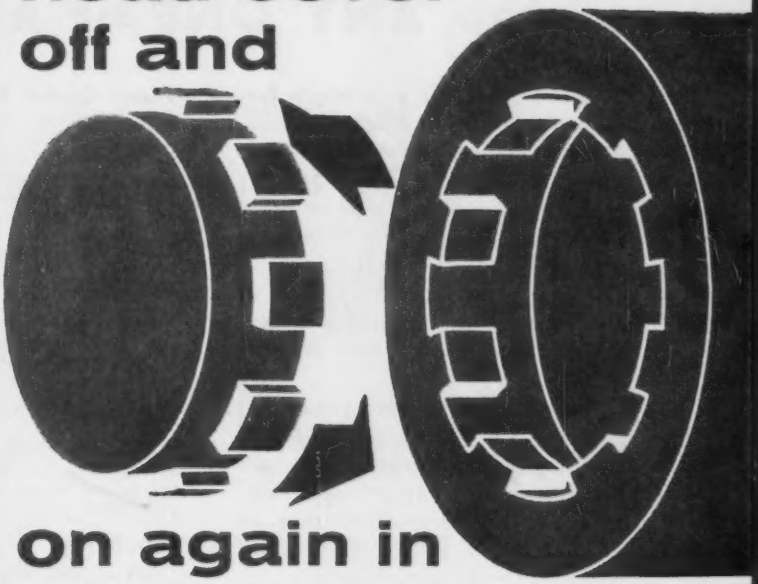








head cover off and



on again in 84 minutes

cuts feedwater heater inspection downtime

Periodic internal inspection of high pressure feedwater heaters is easy and fast with G-R Type "L" breech block heads. The complete operation of cover removal and reinstallation is shown in photographs at left.

When the cover is removed the entire tube sheet and all tube joints are readily accessible for examination and cleaning from outside the heater. No need to squeeze and squirm inside the water head whether heaters are large or small.

G-R Type "L" breech block high pressure heaters are available with all welded seals without gaskets, with rolled or rolled-and-welded tube joints.

More than 1,000 G-R heaters are installed operating at over 1,000 psi. More than 250 are in operation at pressures in excess of 3,000 psi. *This record is unsurpassed by any other American manufacturer.*

G-R high pressure heaters are available in all types and sizes, horizontal or vertical, and are furnished with suitable cover handling rigs.

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Planning to Burn Gas,

You can fire ANY ONE or ALL THREE in a

The Riley TURBO FURNACE is a major furnace design advance for the more efficient utilization of fuels. It is best known as a multifuel unit because of its ability to produce similar furnace exit gas temperatures with gas, oil, coal or other solid fuels. This phenomenon is due to natural gas burning in a TURBO FURNACE with a luminous flame similar to oil and coal. In a TURBO FURNACE, fuels are burned with extremely high turbulence at the furnace bottom.

Much of the unusual combustion efficiency results from opposed firing with Riley Directional Flame Burners which are specially designed for the TURBO FURNACE and for firing multiple fuels singly or in combination. These fuels may be pulverized coal, oil, gas, or other special solid fuels such as fluid coke or lignite.

Water Cooled Burner

The Riley Directional Flame Burner is designed for opposed firing on one level. Each Riley Directional Flame Burner is installed as a unit complete with water cooling tubes which are welded to the waterwall circulation system. The waterwall tube arrangement provides maximum cooling of directional vanes, nozzles and other burner parts and reduces to a minimum the possibility of slag adhesion when coal is being burned. No burner refractories are required.

Coal Burning

Two or three burner nozzles per burner are provided when coal or other solid fuels are to be burned. In this way the coal streams are more evenly distributed across the furnace to assure good mixing of fuel and air in the furnace.

Oil Firing

A retractable type oil gun is inserted thru the center slot so as to provide complete mixing of the spray with the air stream. Oil can be burned with either steam or mechanical atomizing equipment.

Gas Firing

Gas is fired thru guns of high alloy stainless steel. High capacity burners have a gun in each side slot. Gas guns can be installed for mechanical retraction.

Inside the Turbo Furnace at Sterlington Steam Electric Station of Louisiana Power and Light Co. Overall width 54'—7⅞", depth 24'—0-3/16". No. 1 firebrick rubble covers the furnace floor. Twenty Riley Directional Flame Burners are arranged for opposed firing on front and rear walls. Burners are shop fabricated assemblies. Burner close-up shows directional vanes, two

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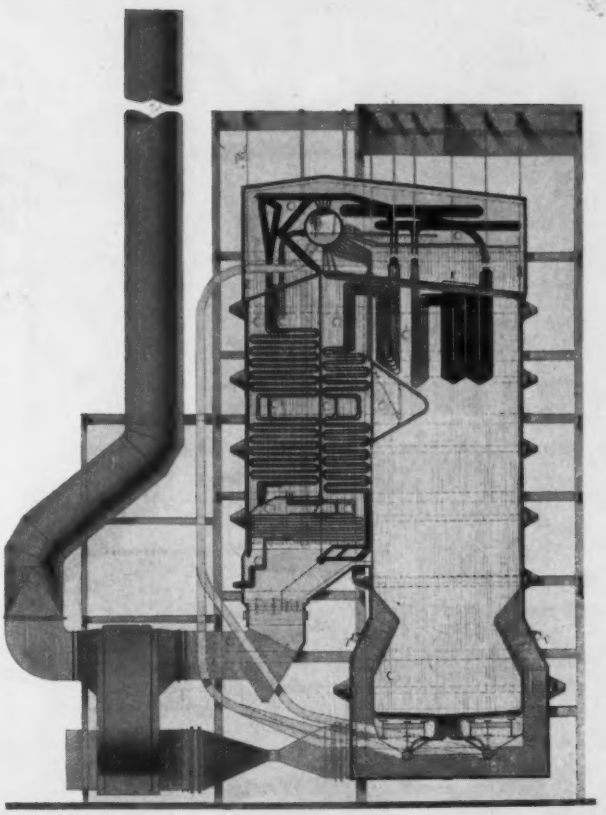
- **The ability to fire multiple fuels: gas, oil and a wide range of solid fuels**
- **A low cost and quick conversion to solid fuels with initial gas/oil firing**
- **Higher heat release with lower overall structure**
- **Minimum Superheater/Reheater metal temperature variations across full width of furnace.**
- **No restrictions on furnace widths.**
- **One level burner operation.**

Oil or Coal?
TURBO FURNACE



Directional Vanes

Each slot is provided with directional vanes to project secondary air into the furnace so as to secure the desired placement of flame for most effective combustion. The vanes above the burner centerline and those below each have separate controls. Vanes are made of high heat resisting alloy.

Burner Shut-Off

Each burner has a separate secondary air shut-off damper which can be locally or remotely controlled.

Riley Gas-Electric Ignitors

Riley Gas-Electric Ignitors are available with Riley Directional Flame Burners.

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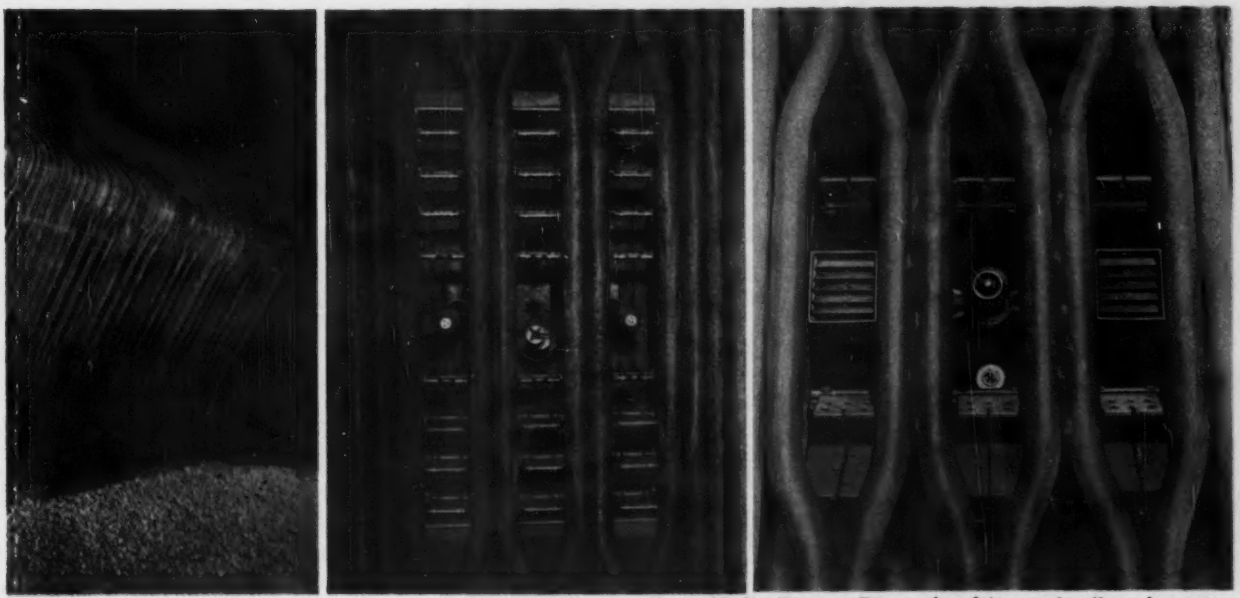
Riley Directional Flame Burners are designed so that they can be used either with pressurized or non-pressurized furnaces.

For the complete description of the Riley TURBO FURNACE write:

RILEY STOKER CORPORATION, Worcester, Mass.



gas guns, gas electric ignitor, observation port. Burner can easily be converted to oil and coal firing. At far right is a Directional Flame Turbo Furnace Burner for firing coal, oil, and gas. Note the complete absence of burner refractory.

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This unique Westinghouse voltage regulator brings immediate relief to secondary distribution problems, offers a new concept in systems design and voltage regulation and provides sound re-regulation under emergency conditions.

UNOREG works on an induction principle with two sets of coils: a rotor and a stator. A solid state control meters the input voltage, actuates the rotor which raises or lowers the output voltage automatically. Its operation is maintenance-free and completely reliable. Contact your Westinghouse sales engineer to learn how other electric utilities are reducing operating costs with UNOREG. Or, write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. *You can be sure . . . if it's Westinghouse.*

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KEARNEY PACE WITH

	Cutout Rating		Type	Interrupting Rating RMS Asymetrical Amperes			Cat. No.
	Volts	Amps		2.6 KV	5.2 KV	7.8 KV	
HD	5200	50	Indicating Non-Indicating	8000	5000		49409
HD	5200	100	Indicating Non-Indicating	8000	5000		49410
EHD	5200	100	Indicating Non-Indicating	14,000	10,000		49411
	5200	200	Dead Blade Disconnect				49410-200
HD	7800	50	Indicating Non-Indicating	8000	5000	4000	49412
HD	7800	100	Indicating Non-Indicating	8000	5000	4000	49413
EHD	7800	100	Indicating Non-Indicating	14,000	10,000	8000	49414
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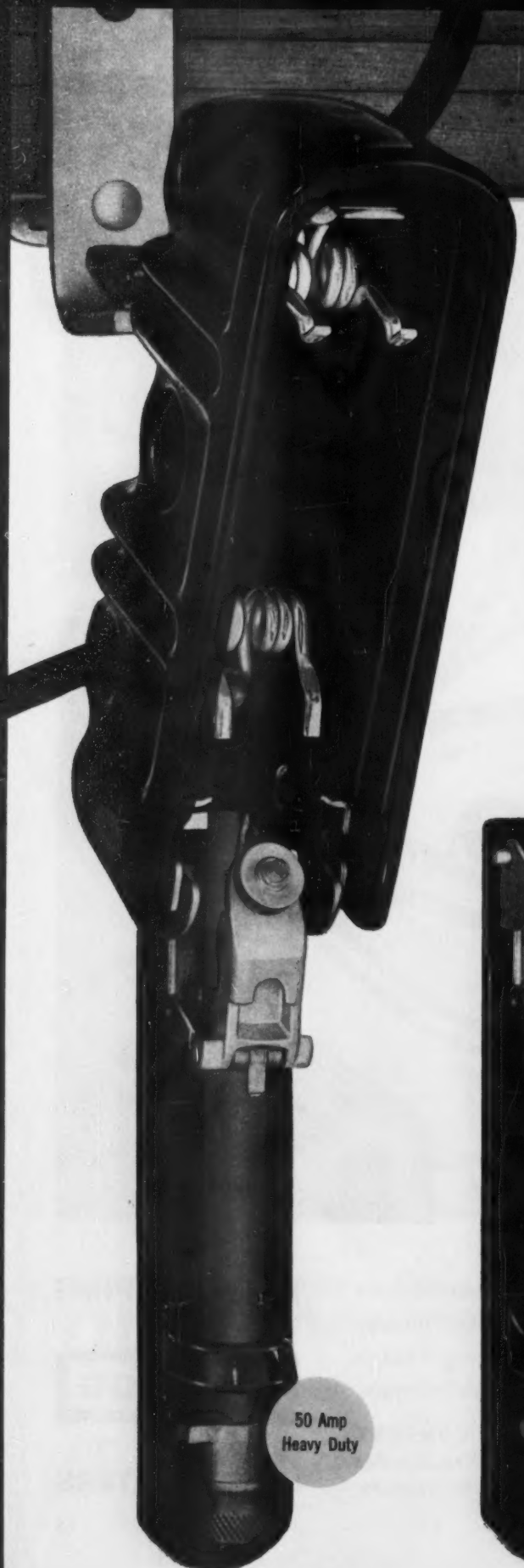
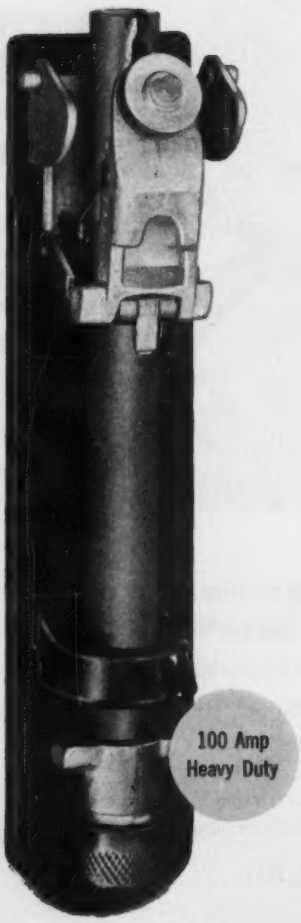
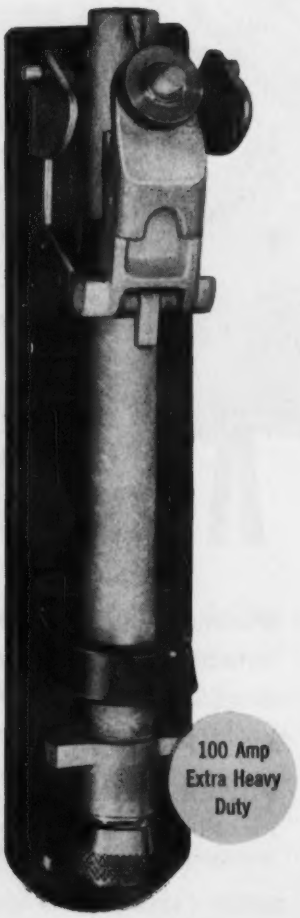






ENCLOSED CUTOUTS KEEP EXPANDING SYSTEM NEEDS!

...can be inexpensively uprated any time in the future...by simply changing doors

Kearney Enclosed Cutouts provide an ideal solution to a perplexing, two-fold problem faced by many power systems today:

First, that of specifying low-cost, dependable fault protection fully adequate for present needs, yet adaptable enough to comply with the future requirements of a rapidly expanding system... and second, that of uprating to the levels of future system demands without incurring exhorbitant and unnecessary costs of usable product obsolescence.

In addition to their low first cost, Kearney Enclosed Cutouts give greater long-range value for every cutout dollar... because they can be quickly and inexpensively uprated in continuous ampere rating, interrupting rating, or both, by simply changing doors... whenever expanding system requirements make it necessary. Each of two porcelain boxes accepts four interchangeable door assemblies and provide adequate interrupting capacities to meet any future needs up to 8,000 amperes at 7.8 KV, 10,000 amperes at 5.2 KV and 14,000 amperes at 2.6 KV.

Buy now and plan ahead for the future. By specifying Kearney Enclosed Cutouts now, you can minimize inventories, reduce ultimate maintenance costs, eliminate the high cost of later removal and replacement of entire units... and be prepared to meet future system demands for dependable fault protection.

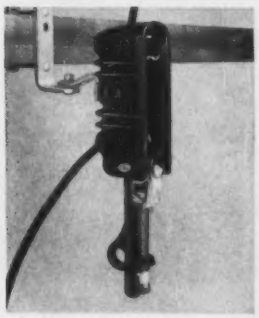
Important Design Improvements...

Economy, higher interrupting capacities and interchangeability of doors have been achieved with no increase in price or sacrifice of high quality. Improved lower trunnion construction permits entire recoil thrust to be absorbed by the trunnion, porcelain box and a heavy duty hanger rather than by the upper contacts; thus high pressure low-resistance contact is maintained during each interruption and throughout the service life of the cutout. Heavy duty hangers are standard equipment on all Kearney Enclosed Cutouts, to adapt the cutout to future system requirements.

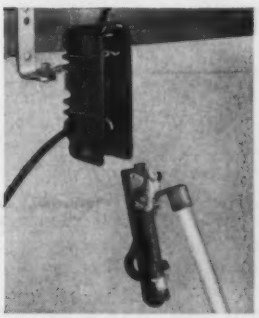
A highly efficient spring flipper whips fuse link cable out of cartridge, assures positive low fault interruption. Re-fusing is simple, foolproof... cartridge locks in position even if lineman fails to snub fuse link leader tight ... contact pressure cannot change.

Lengthened cartridge tube projects slightly below the box to prevent any deflection of ionized gas which might cause internal flashover.

Plated, box-type terminals accommodate up to 4/0 stranded copper and aluminum conductor. All current carrying parts are non-ferrous. Duronze hinge pins, silver-to-silver contacts. Bolt-thru construction of contacts, brackets and terminals... parts cannot loosen or pull out of housing.



Doors drop out to full 180° angle in the indicating position.



Doors may be easily removed or inserted from any angle with standard hookstick.

Easily converted to non-indicating by inserting only one screw.

For complete information contact your Kearney Sales Representative

for better construction... safer maintenance... specify KEARNEY products

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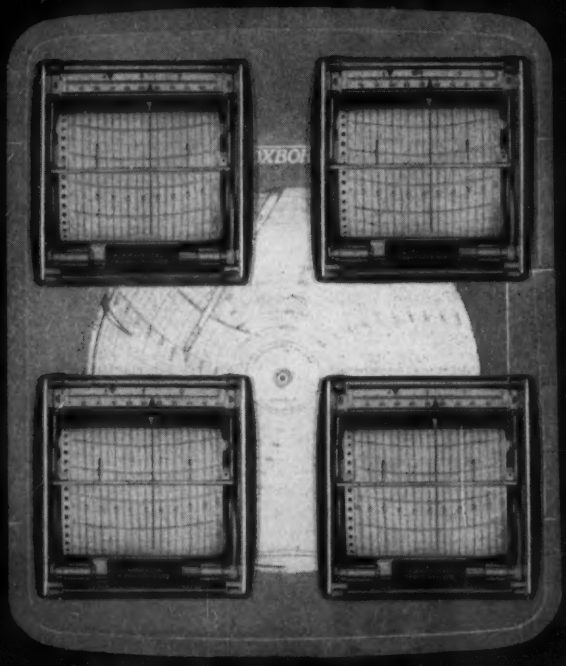
PLANTS AT: ST. LOUIS • MELROSE PARK, ILLINOIS • FAYETTEVILLE, ARKANSAS • GUELPH, ONTARIO, CANADA • ST. THERESE, QUEBEC, CANADA

515

SAVE 75% OF YOUR PANEL SPACE without SACRIFICE OF FULL-SCALE RECORDS!



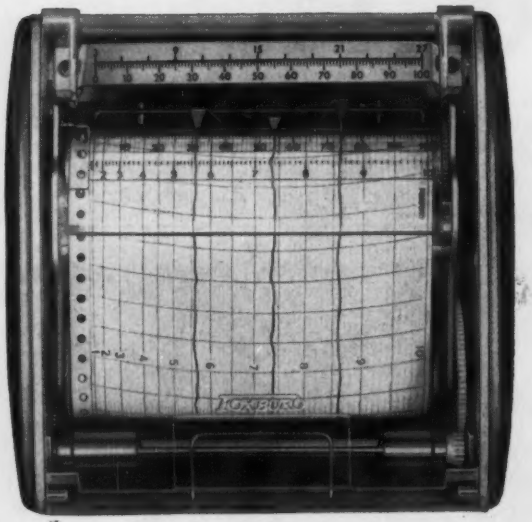
Foxboro CONSOTROL* Recorders

Yes, you can actually mount up to 4 Foxboro Consotrol Recorders in the panel space ordinarily required for one conventional-size instrument — and get a full-scale, 4"-wide chart record from each one! Or, using 3-pen Consotrol Recorders, get a total of 12 full-size records in the same panel space!

This unique combination of compactness and high readability is in *addition* to the outstanding convenience Consotrol Recorders provide. They're by far the simplest to maintain . . . inking only once every 6 months; chart replacement every 30 days. And the chart loads quicker and easier than a box camera!

With Consotrol Recorders you can put records of *all* important trends on your console without crowding or limiting visibility. The same compact Consotrol design also is available with automatic control functions. Get full details on the complete modern Consotrol Line. Write for Bulletin 13-18. **The Foxboro Company, 2410 Norfolk St., Foxboro, Mass.**

*Reg. U. S. Pat. Off.



(½ actual size)
Available in 3-27 psi or
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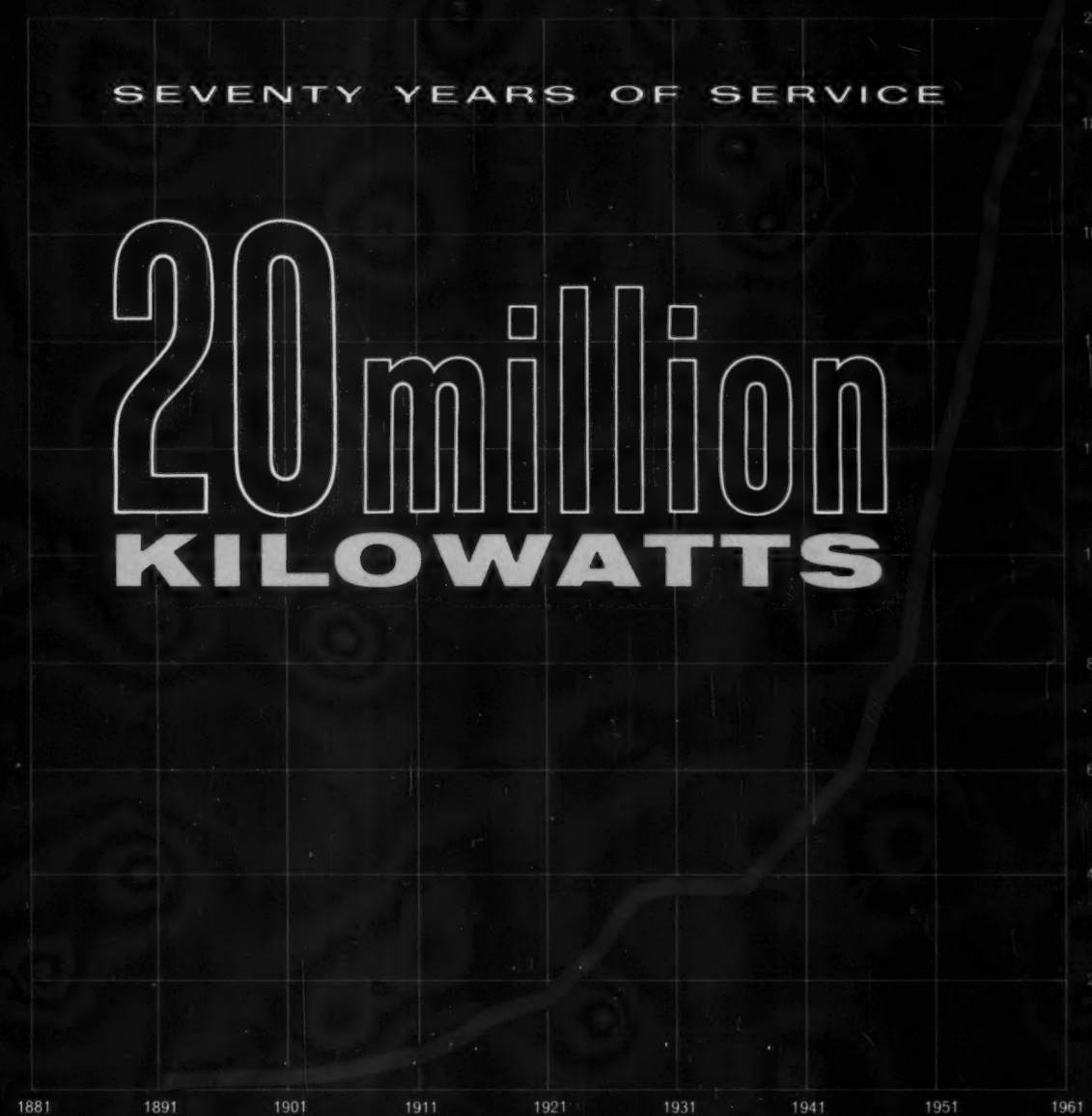
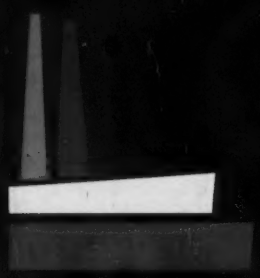
20 million KILOWATTS



For 70 years Sargent & Lundy has been devoted to the engineering of steam electric generating stations and power systems.

With a background of 20,000,000 kilowatts in projects authorized and engineered, Sargent & Lundy serves its clients in the areas of system planning, site selection, studies and evaluations, and conventional and nuclear plant design.



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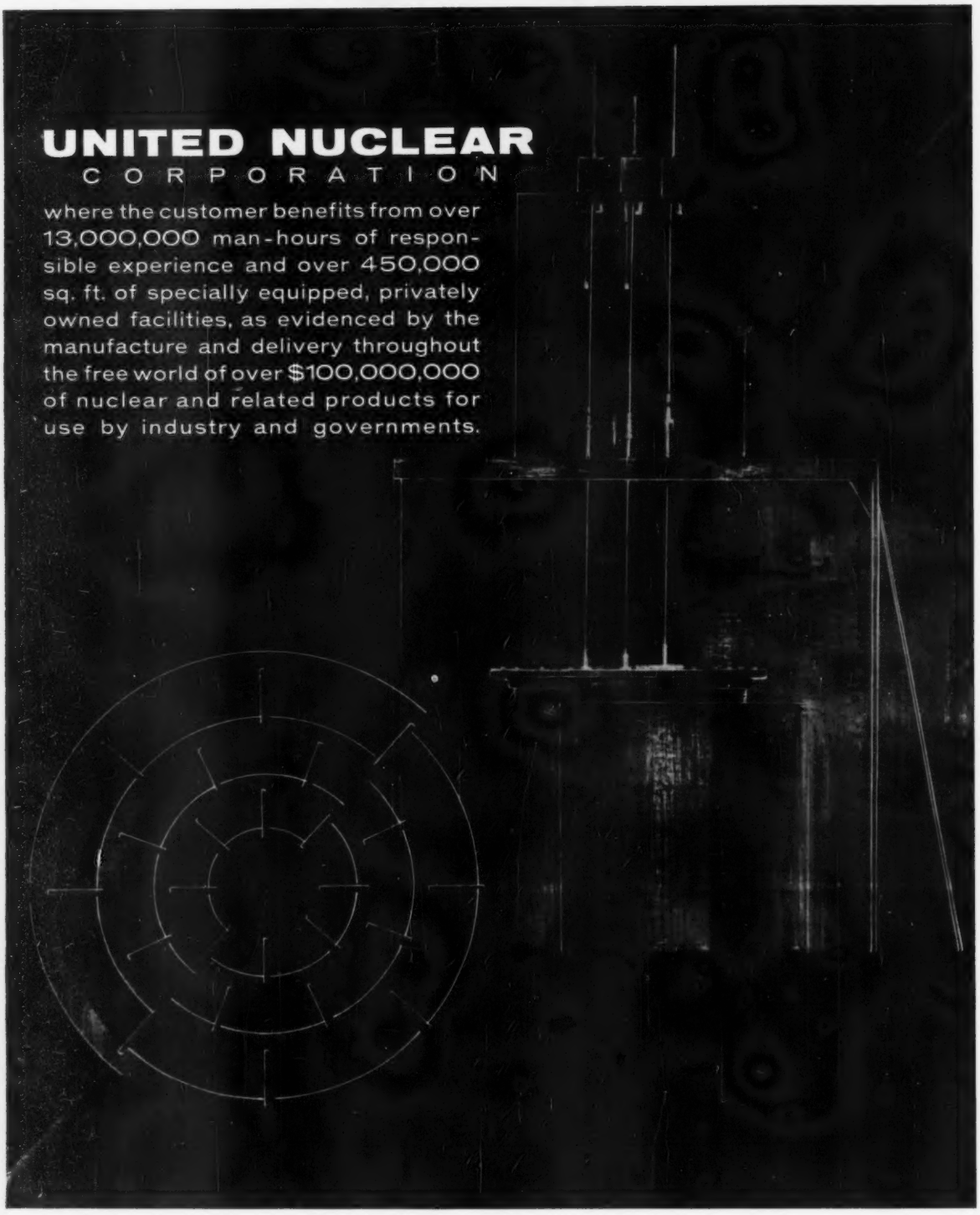
where the customer benefits from over 13,000,000 man-hours of responsible experience and over 450,000 sq. ft. of specially equipped, privately owned facilities, as evidenced by the manufacture and delivery throughout the free world of over $100,000,000 of nuclear and related products for use by industry and governments.



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Electrical World

OCTOBER 2, 1961
Vol. 156, No. 14

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● 12th STEAM STATION COST SURVEY finds busbar energy cost for new plants in 1960 20% below decade ago. Heat rates stand today at the lowest level yet attained, as a consequence of bigger stations, bigger units, improved steam conditions and widespread use of reheat. Station costs, however, are at a 10-year peak of $152.50 per kw. The fuel cost situation is generally favorable. Although cost of fuel consumed is 19% higher than in 1950, it has declined four percentage points from its 1958 peak level..... 69

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NEXT WEEK

FROM NATCHEZ TO RED GUM, valve-type lightning arresters will replace overhead ground wires on Louisiana P&L's 115-kv Mississippi River crossing.

The Electrical Week

LATE NEWS ▶ **Formation of a single national group to set policy,** coordinate and spark all national aspects of electrical space heating marketing, promotion and production, and system innovation is recommended to more than 300 at *Electrical World's* heating conference in Washington, D. C. Editor C. F. Hochgesang terms the step a "must" to get a single-industry drive for this "pivotal load," in view of growing vulnerability to the gas industry's focused approach threatening all electrical loads.

State regulatory agencies are urged to lend their support and prestige to President Kennedy's efforts to reform and streamline the major federal agencies by Peter Mitchell, outgoing president of the National Assn of Railroad and Utility Commissioners. Charles Tatham, Bache & Co, tells the NARUC annual convention in Atlantic City that investors are willing to pay high prices for electric utility stocks because they expect a higher return in the future. If these investors are given reason to think that the future will not bring the higher returns they expect, he added, they will invest their capital elsewhere.

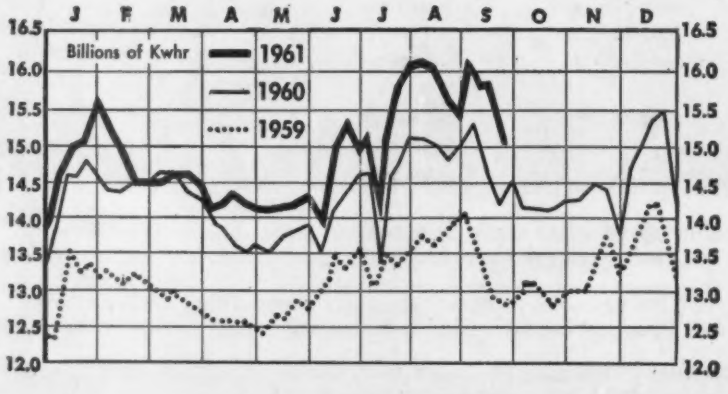
First test of England's wage-pause policy for state industries is instituted by electricity supply workers. They are asking for $5.60 a week increase for 120,000 workers, which would cost the government more than $33.6 million a year, and might cause a hike in electric rates.

Predicting that by the year 2000 electric power production will need to be in the range of 6 to 10 trillion kwhr, Philip A. Fleger, president of Edison Electric Institute, told the Pennsylvania Electric Assn, "We offer our pledge the capacity to produce this power can be wholly provided under the free enterprise system, and financed entirely by the free money market."

British Columbia Premier W. A. C. Bennett indicates the provincial government will disregard plans of British Columbia Power Corp to sue the government for more money from the acquisition of British Columbia Electric Co by the government. He cites a legislative clause preventing suits against B. C. Electric unless government permission is granted (see p 64).

Westinghouse signs definitive contract for a 242-Mw underground French-Belgian nuclear power plant. Two European licensees of Westinghouse will assist in the construction of the closed-cycle water reactor for the SENA utility group. The plant comes under the Euratom-AEC bilateral joint assistance program which includes 10-year financial guarantee of fuel elements, long-term Import-Export Bank loans, and purchase or lease of US nuclear fuel.

WEEKLY POWER OUTPUT—Up 3.2% (Week ending Sept. 23), Kwhr 15,025,000,000



Per Cent Change From Previous Year

	Sept. 9	Sept. 16	Sept. 23
Total U.S.	+ 8.4	+11.0	+ 3.2
New Eng.	+11.1	+19.3	+ 8.5
Mid. Atlan. ...	+20.0	+21.3	+ 7.9
Cent. Indust. ..	+ 6.5	+10.0	+ 4.4
West Cent.....	— 0.9	+13.5	+ 2.7
Southeast	+ 8.5	+11.1	+ 4.5
South Cent. ...	+ 4.7	+ 2.5	−12.9
Rocky Mount...	+ 4.4	+11.8	+ 1.9
Pacific			
NW	+ 3.1	+ 5.8	+ 3.0
SW	+ 8.9	+ 6.8	+ 6.7

Seasonally Adjusted Index 290

Week Ago 304 Year Ago 281

Source: Edison Electric Institute

Supply Lines

LOS ANGELES DAMAGE ACTION SPOTLIGHTS SUPPLIERS' IRRITATION

A federal judge will continue hearings Oct. 10 on a motion by the Los Angeles Department of Water & Power to cut the number of defendants named in damage suits the department filed as a result of the Philadelphia antitrust cases. The new hearing was set after the judge heard arguments from General Electric Co counsel that the Los Angeles motion mentioned no reason for dropping some of the defendants from the suits (EW, Sept. 4, p 16).

GE charged that some of the defendants that had made no sales to Los Angeles would be kept in the suits, while others that had made substantial sales during the time involved would be dropped. And GE filed with the court a list of the purchases made by LADW&P from each company during the time involved, which GE felt would show the capriciousness of LADW&P in deciding whom to drop. This list is shown below, with the asterisks denoting the instances where LADW&P is seeking to delete defendants:

	Circuit Breakers	Distribution Transformers	Power Transformers	Power Capacitors	Power Switchgear Assemblies
General Electric	$1,181,175	$1,258,531	$ 0	$ 0	$ 0
Westinghouse	685,795	1,221,316	0	115,263	282,632
Allis-Chalmers	160,320	253,853	0		0
I-T-E	*350,433				*0
Federal Pacific	*316,205			*0 †	* 23,506
McGraw-Edison		534,427	286,000	148,480	
Moloney		*54,660	*389,504		
Wagner		*0	*0		
Ohio Brass				133,600	
Sangamo				*0	
Kuhlman		*0			

* Companies sought to be dropped in each suit
†Sued under name of Cornell-Dubilier

In its argument, GE said a public body has a higher duty to act reasonably without pure caprice than an individual, and that it is the duty of the public body to enforce the law impartially. The judge, in continuing the motion, stated that he wanted to know if there is any basis for this distinction between public bodies and private individuals, and in a situation of this sort, whether the plaintiff, LADW&P, has to show affirmatively that the proceedings are just and fair.

LADW&P apparently was caught by surprise by the GE brief and unsuccessfully argued to have it thrown out on a technicality. Westinghouse Electric Corp and Allis-Chalmers Manufacturing Co supported GE's contentions at the hearings.

Regardless of the outcome and the legal basis for the judge's decision, this skirmish brings to the surface a fact of life that has begun to grate the manufacturers: that legally, all parties to a conspiracy are theoretically equally liable for damages, whether or not they individually sold equipment to the utility suing for damages.

In this particular instance, according to GE's figures, GE is being sued five times, when, in three of those five cases, it didn't sell to LADW&P any equipment involved

during the time of the conspiracies. Obviously, with the total number of damage suits GE is named in now approaching 100, the company would like to trim this number wherever possible.

For the smaller manufacturers, they too, don't like to be named as defendants by a buyer, when, as one puts it, "for years we haven't been able to get on the utility's approved list." They acknowledge that a utility has a perfectly legal right to do so, but they question whether utilities are not being shortsighted in naming non-suppliers as defendants. And many of the smaller suppliers say they can each cite several suits they are named in where they never supplied the product involved to the utility.

The smaller manufacturers' main argument is that being sued costs money, even before any litigation takes place. They reckon $5,000 per suit as a routine legal fee for services up to the time of trial and they say that this money has to come from somewhere, whether it be profits, research and development cutbacks, selling efforts, etc. As a result, they wonder whether it wouldn't be in the utility's best interests to sue, not across the board, but only those companies from whom it bought equipment involved during the conspiracies.

US GOVERNMENT, NEW JERSEY FILE DAMAGE SUITS

The US government has filed its eighth damage suit against electrical manufacturers. This last one involves insulators and some nine manufacturers are named as defendants. The suit, which seeks up to triple damages, was filed on behalf of Tennessee Valley Authority, Interior Department, Corps of Engineers, the Air Force, and the Marine Corps.

Meanwhile, the state of New Jersey also has filed a damage suit, with power switchgear assemblies and distribution transformers as the products involved. Triple damages are sought from nine manufacturers.

IDENTICAL BID REPORT PUBLISHED BY CONGRESSIONAL COMMITTEE

Congress' Joint Economic Committee has published a report of identical bids received by government procurement agencies from 1955 through 1960. But the report, which was promised by the committee several months ago, says the figures are inconclusive because they represent only a "small sample" of identical bids received by the government. And the meaning of the 139 pages of statistics is at best vague.

Rep Wright Patman (D-Tex.), chairman of the committee, called for publication of the report on the basis that simple publicity of identical bids would tend to discourage identical bidders from making them. This followed an order by President Kennedy that all identical bids over $10,000 be reported to the Justice Dept. It is from these Justice Dept reports that the committee compiled its report. But Justice, to get its job down to workable size, compiled statistics from only one-fifth of the reports it had received.

Identical bids on electrical machinery cover 54 pages of statistics in the report, mostly on bids to Interior Dept projects. Transformers, switchgear, batteries, etc., made by a wide range of manufacturers, are included in the report.

Ray Rowe, Product Manager, Protective Equipment and Capacitors, exhibits first production sample of the new economy type EDO fuse cutout. Built to meet the demand for low price, it offers many desirable features. Ask the L-M Field Engineer to show you a sample.

New $16 L-M Open Type EDO Fuse Cutout Meets Need For Economy, Performance

To fill the requests of many operating companies for an economically priced, medium duty, open type cutout, L-M offers the Type EDO. Designed for savings plus performance, the EDO can be used with complete assurance where high fault capacity is unnecessary. Although maximum interrupting capacity is below present NEMA standards, the EDO has been tested and proved over the range of operations for which it has been designed.

The EDO has many desirable features, developed through L-M's many years of experience as a leader in fuse cutouts. The unit is small, compact. Fuse tube closes fully from any angle. Takes any standard button-head link. Fully bird-proof. Non-ferrous current-carrying parts. Rated at 100 amperes. The 7.8 kv unit costs as little as $16; the 15 kv is as low as $18. Available with link-break attachment if desired.

RATINGS AND INTERRUPTING CAPACITIES

Voltage Rating —KV	Current Rating— Amperes	Interrupting Capacity— Amperes	Minimum 60 Cycle 1 Minute Dry Withstand Voltage —KV RMS*	Minimum 60 Cycle 10 Second Wet Withstand Voltage	Impulse Withstand Voltage on 1½ x 40 Microsecond Wave—KV*
7.8	100	3000	27	24	75
15	100	2000	35	30	95

*In accordance with "NEMA Standards For High Voltage Fuses," Section SG2-3.18.

Get complete information on fuse cutouts

L-M offers a complete line of protective equipment, including a variety of both open and closed cutouts. Ask the L-M Field Engineer for information from L-M's extensive file on system protection. Or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: CLM Industries, McGraw-Edison (Canada) Limited, Toronto 13, Canada.

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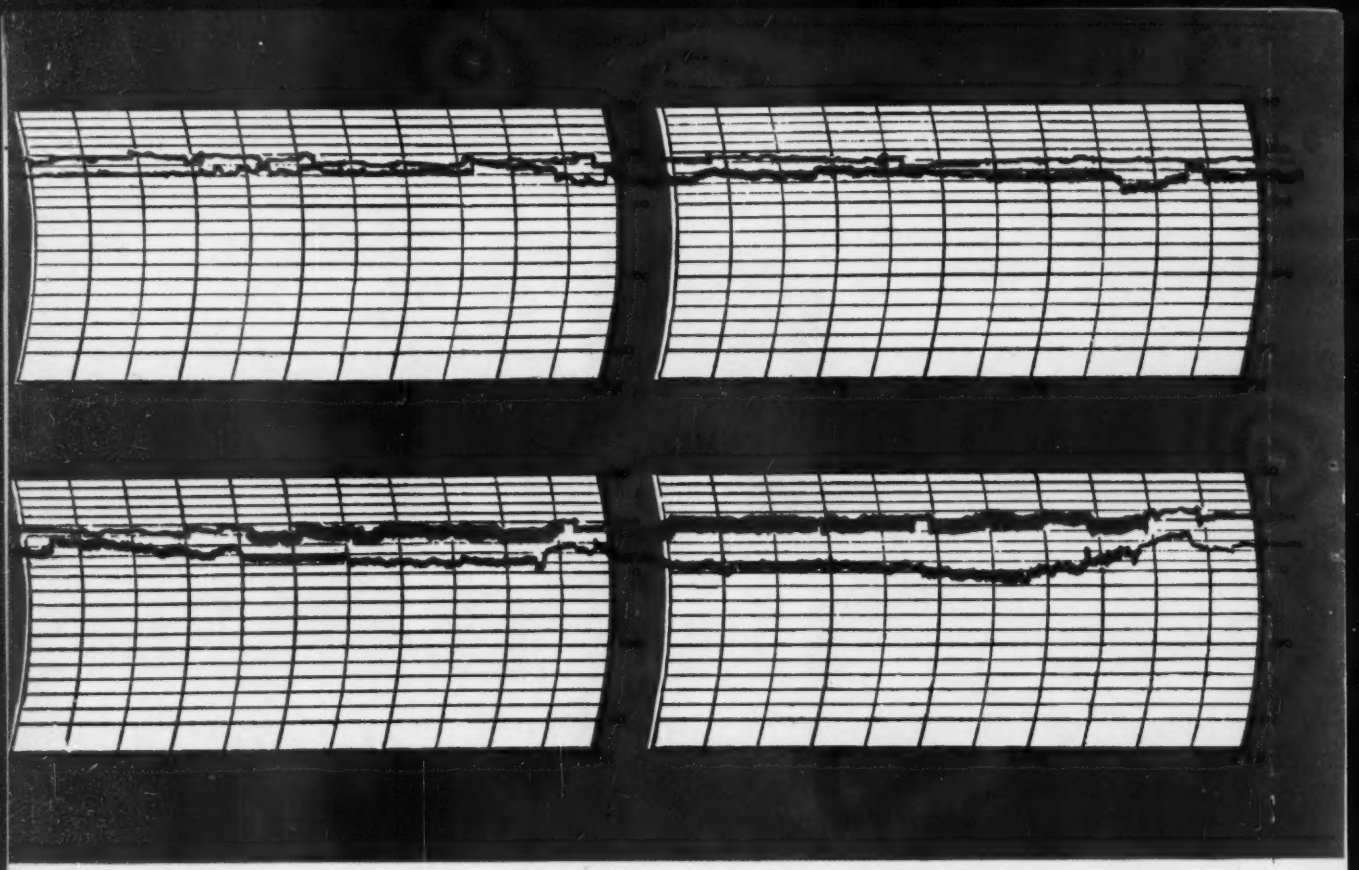


THESE TYPICAL VOLTMETER CHARTS show what happened when an SRT Transformer replaced a conventional transformer at an industrial load. The black line shows typical voltage variations with the conventional transformer, the blue line, which has been superimposed for comparison, shows the typical voltage with the SRT. Note the former steady voltage drop after 7 A.M., and the way voltage was levelled out by the SRT Transformer. With the conventional transformer, voltage ranged from a low of 108 volts to a high of 120. In comparison, note the uniformity of the voltage with the SRT Transformer. This enabled the utility to realize a substantial increased annual revenue, which much more than covered the added cost of the SRT Transformer.

SRT® Transformers Pay Own Cost With $1 Per Kva Increased Annual Revenue

L-M SRT Transformers provide consistently good voltage at utilization point; maximize revenue.

by **A. R. Waehner**
Director of Transformer Product Sales
Line Material Industries

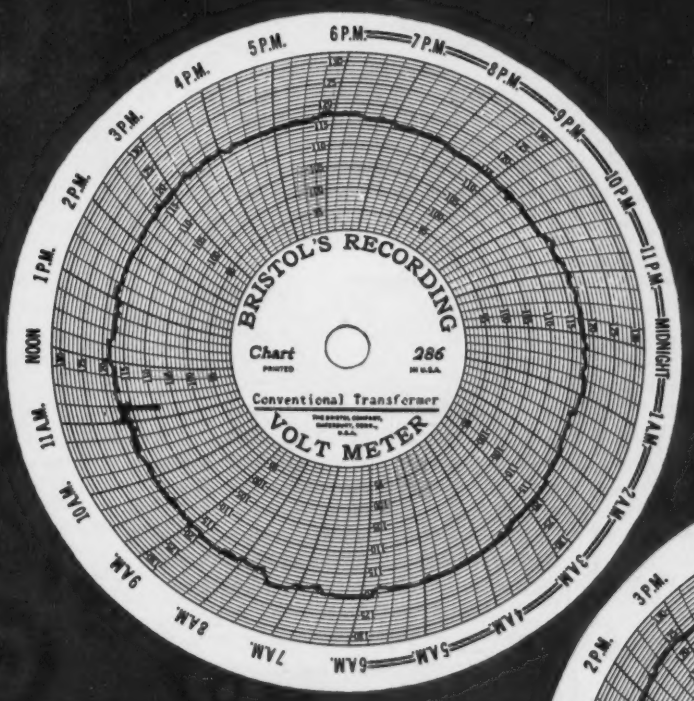
L-M Self-Regulating Transformers provide the ideal way to keep utilization voltage at the optimum level. As load varies, the SRT changes tap positions automatically to assure a regulated secondary output of 123 volts. The electronically controlled self-regulating mechanism assures optimum voltage at all times, with a conservative increase in annual revenue of $1 per kva of nameplate rating. Thus a 25 kva SRT Transformer increases revenue about $25 a year, $50 for a 50 kva, and so on. The increased revenue alone more than covers the cost of the SRT service.

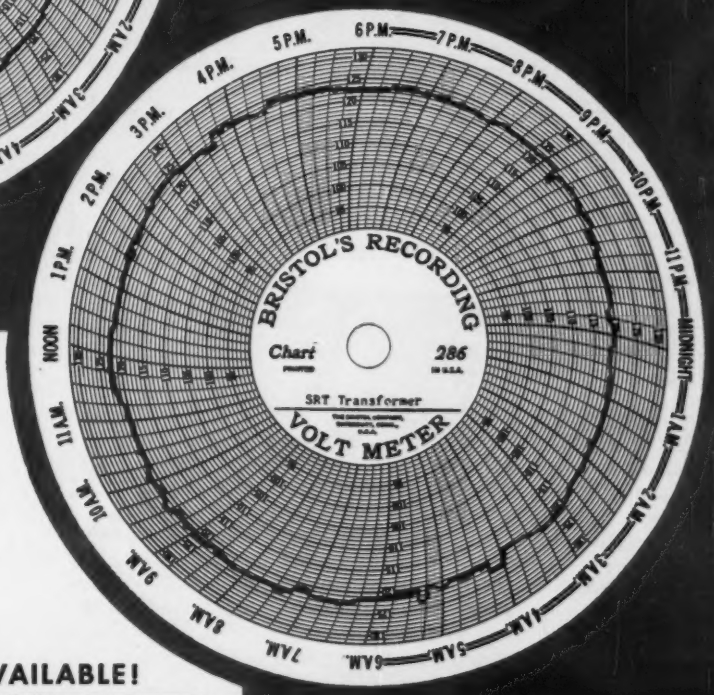
Thus, over and above the customer satisfaction and good will produced by the better service provided, the L-M SRT Transformer pays for itself in actual dollars returned to the utility.

Economic parameters vary in each utility. L-M has programmed its computer to assist you to evaluate the economic benefits of SRT based on your own values. Bulletin No. 61144 (available on request) provides you with an easy means to submit your data. Using your parameters, we will compute the dollar savings SRT Transformers can earn for you.

Dollar savings were calculated on the basis of the following assumptions:

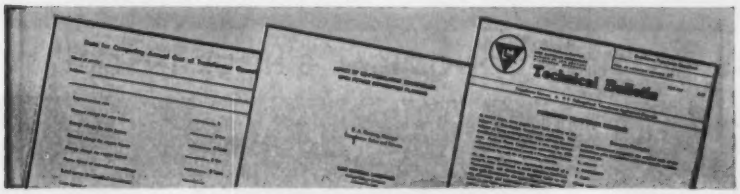
1. **an annual peak load on each self-regulating transformer equal to 150 percent of nameplate kva**
2. **load factor of 35 percent**
3. **power factor of 85 percent**
4. **each two-percent increase in voltage increases kwhr consumption one percent**
5. **each additional kwhr sold increases net revenue one cent**





TYPICAL VOLTAGE CHARTS before, and after, an SRT Transformer was installed at a location serving both commercial and residential customers. Both transformers were 50 kva units. Note that the average voltage was increased. The SRT particularly corrected the typical evening voltage sag from 7 to 10 P.M., when voltage formerly dropped as low as 114 volts. Peak loads were as high as 65 kva on both transformers. The voltage improvement by the SRT Transformer was as much as 12%. This voltage improvement resulted in an average annual revenue increase which more than justified the cost of the SRT Transformer.

NEW SRT BULLETINS NOW AVAILABLE!



Ask your L-M Field Engineer, or write L-M, for copies of these bulletins:

- **No. 61144: Data Form For Computing Annual Savings**
- **No. 61046: Impact of Self-Regulating Transformer on Future Distribution Planning, by D. A. Manning**
- **No. TDT-110: Distribution Transformer Economics, by H. Hollingshead**

Line Material Industries, Milwaukee 1, Wisconsin.

WITH THE NEW ELECTRONIC CONTROL, the SRT Transformer offers even greater flexibility and accuracy. The external control is easily accessible. Band midpoint is accurately adjustable from 120 to 126 volts.

OUR 50TH YEAR 1911 — 1961

LINE MATERIAL® Industries

McGRAW-EDISON COMPANY

Transformers

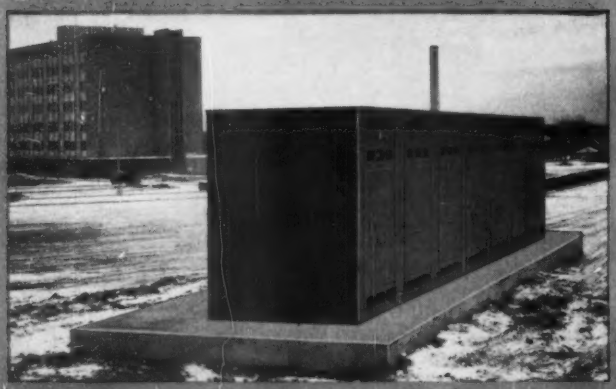
McGRAW EDISON

526

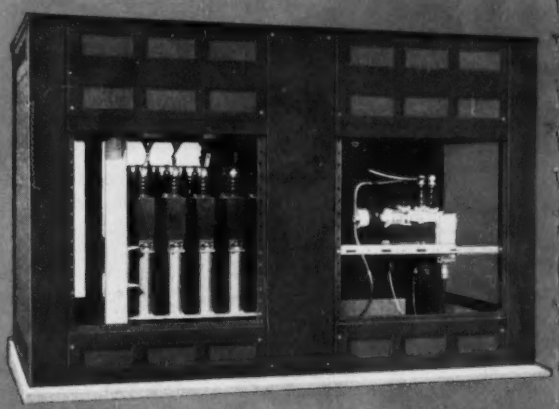
DISTRIBUTION TRANSFORMERS · RECLOSERS, SECTIONALIZERS AND OIL SWITCHES
FUSE CUTOUTS AND FUSE LINKS · LIGHTNING ARRESTERS · POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS · CAPACITORS · REGULATORS · OUTDOOR LIGHTING
LINE CONSTRUCTION MATERIALS · PORCELAIN INSULATORS · FIBRE PIPE AND CONDUIT

L-M TRANSCLOSURE HOUSING containing load transfer equipment. Switching is performed by two L-M 14.4 kv 400 ampere oil switches. Sensing voltage obtained from two potential transformers mounted in the housing activates the L-M type S control, which in turn opens and closes alternate circuits to assure a continuous flow of power to the load. Each oil switch is equipped with a manual group-operated disconnect switch to permit rapid and safe maintenance. When the manual disconnect switch is in the raised position, the oil switch can be rolled out of the housing for inspection or maintenance.

OVERHEAD RESIDENTIAL DISTRIBUTION was resulting in distortion of radio waves from a U. S. Air Navigation VORTAC facility 2000 feet away (left). It became necessary to install distribution underground. To avoid the high cost of underground vaults and submersible equipment, the utility used L-M Transclosure housings with conventional pole type distribution equipment (right). Results: L-M Transclosures provided an economical solution with better accessibility.



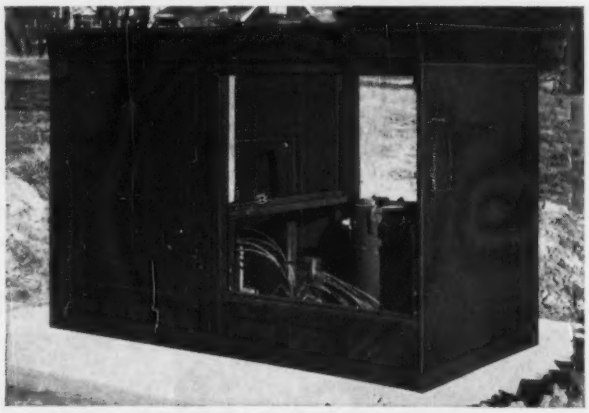
SEVEN L-M TRANSCLOSURE housings are ganged to provide safe protection for street lighting regulating and control equipment at West Allis, Wisconsin. Five regulators plus all controls for five lighting circuits are now housed in this attractive installation. A substantial saving over brick construction was realized.



THESE TRANSCLOSURES HOUSE a pre-fabricated 600 kvar, 3-phase capacitor block. Installation includes controls, switches and bus. Savings of thousands of dollars can be made over conventional housed capacitors.

L-M TRANSCLOSURE HOUSINGS PROVIDE ECONOMICAL 3-HOUR INSTALLATION

HIGHWAY LIGHTING, U. S. 141, WISCONSIN: To house transformer, protective and switching equipment for a 4-way highway intersection, L-M Transclosures were selected. Here they are, as they arrived, in crates. At 12:40 p.m. crew went to work.



3:50 P.M., THREE HOURS LATER. Transclosure frames were bolted to the pad, side panels attached, equipment installed, ready for wiring—all by a crew that had never before seen this equipment. Time was cut substantially as the crew gained experience.

CONTROLS FOR LIGHTING the athletic fields and parking lots at a midwest high school are contained in this Transclosure housing. The double unit shown contains seven L-M type NR oil switches, and high voltage primary terminations and fusing.

L-M's Transclosure™ Housings Economical For All Types Of Distribution Equipment

Modular construction and range of sizes ideal for all types of equipment including transformers, regulators, reclosers, switches, protective equipment, controls, meters, capacitors, load transfer equipment, arresters, buses and insulators.

L-M Transclosures are fabricated steel housings featuring modular design. They can be installed singly or ganged, in a variety of sizes, to house almost any imaginable type of distribution equipment. Additional units may be added at any time.

You have complete flexibility of installation. Transclosures can be installed outdoors at ground level on concrete pads for underground distribution. They are equally versatile on roof tops or indoors. You can install them anywhere. They eliminate the need of expensive vaults or masonry cubicles.

Adequate ventilation is provided for all equipment. Vents at top and bottom have baffles preventing the entrance of all foreign objects, including wildlife. Removable panels can be locked in place to prevent the entrance of all unauthorized personnel.

Get Specifications, Details

Contact your L-M Field Engineer. He's anxious to discuss your enclosure problem with you. Ask him for Bulletins on L-M Transclosure housings. Or write Line Material Industries, Milwaukee 1, Wisconsin

L-M TRANSCLOSURE HOUSINGS at Bartlett Memorial Hospital, Sapulpa, Oklahoma. Three Transclosures are ganged to enclose two 50 kva, one 75 kva distribution transformers, and current transformers. Metering cabinet is shown at end of unit. Complete erection, including assembly and bolting, required only 8 man-hours of labor.

OUR 50TH YEAR 1911 – 1961

LINE MATERIAL® Industries

McGRAW-EDISON COMPANY

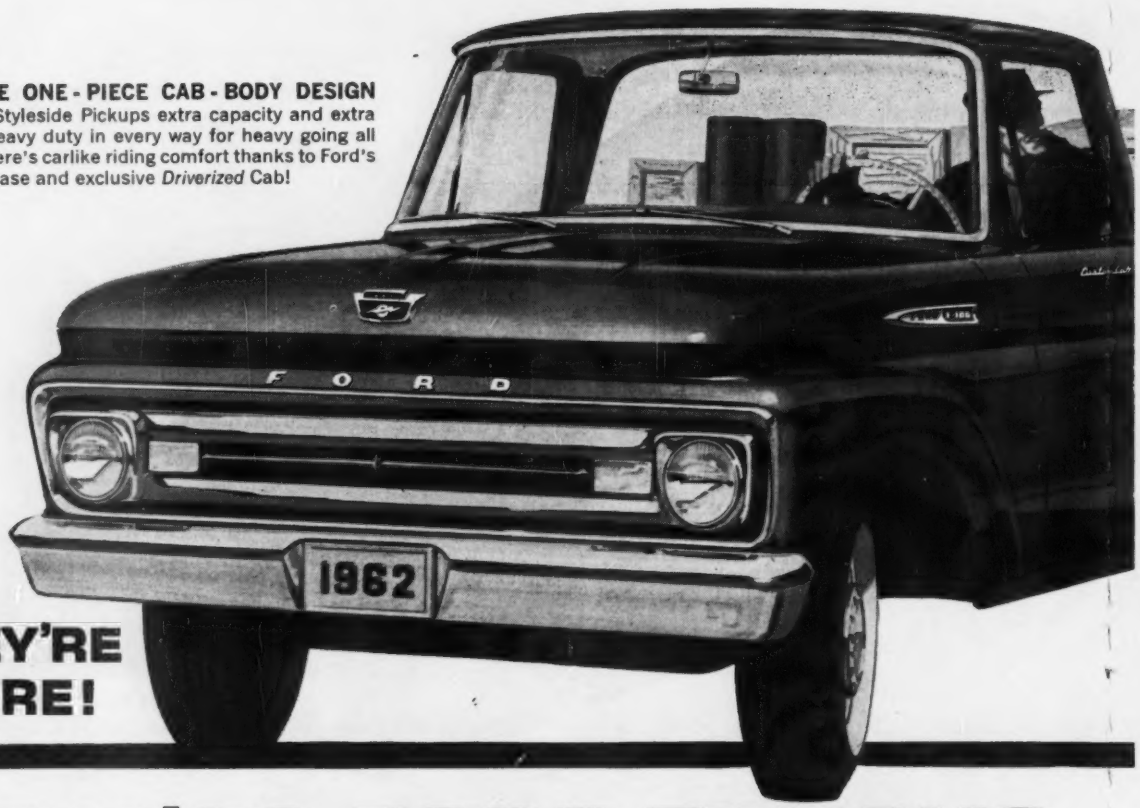
Transclosures

McGRAW EDISON

529

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT

EXCLUSIVE ONE-PIECE CAB-BODY DESIGN gives Ford Styleside Pickups extra capacity and extra strength. Heavy duty in every way for heavy going all day! And there's carlike riding comfort thanks to Ford's long wheelbase and exclusive *Driverized* Cab!



THEY'RE HERE!

NEW '62 FORD TRUCKS

Get full-time economy that only starts with Ford's low price!

Meet the trucks that make saving money a full-time business—new Ford Trucks for '62!

In a selection of over 600 models there's a truck that's right for your job, whatever your job . . . trucks that you can buy and operate at lower cost . . . trucks that can save you money mile after mile, load after load, year after year!

They save on price. They save on gas and oil. They save on tires and on maintenance—wherever there's a way to save! The full record of Ford economy, covering three years of independent tests, is detailed in Ford's Certified Economy Reports. See your Ford Dealer now. Check out the facts, work out a deal, and drive out a truck that saves money . . . full time!

FORD TRUCKS COST LESS

SAVE NOW . . . SAVE FROM NOW ON!

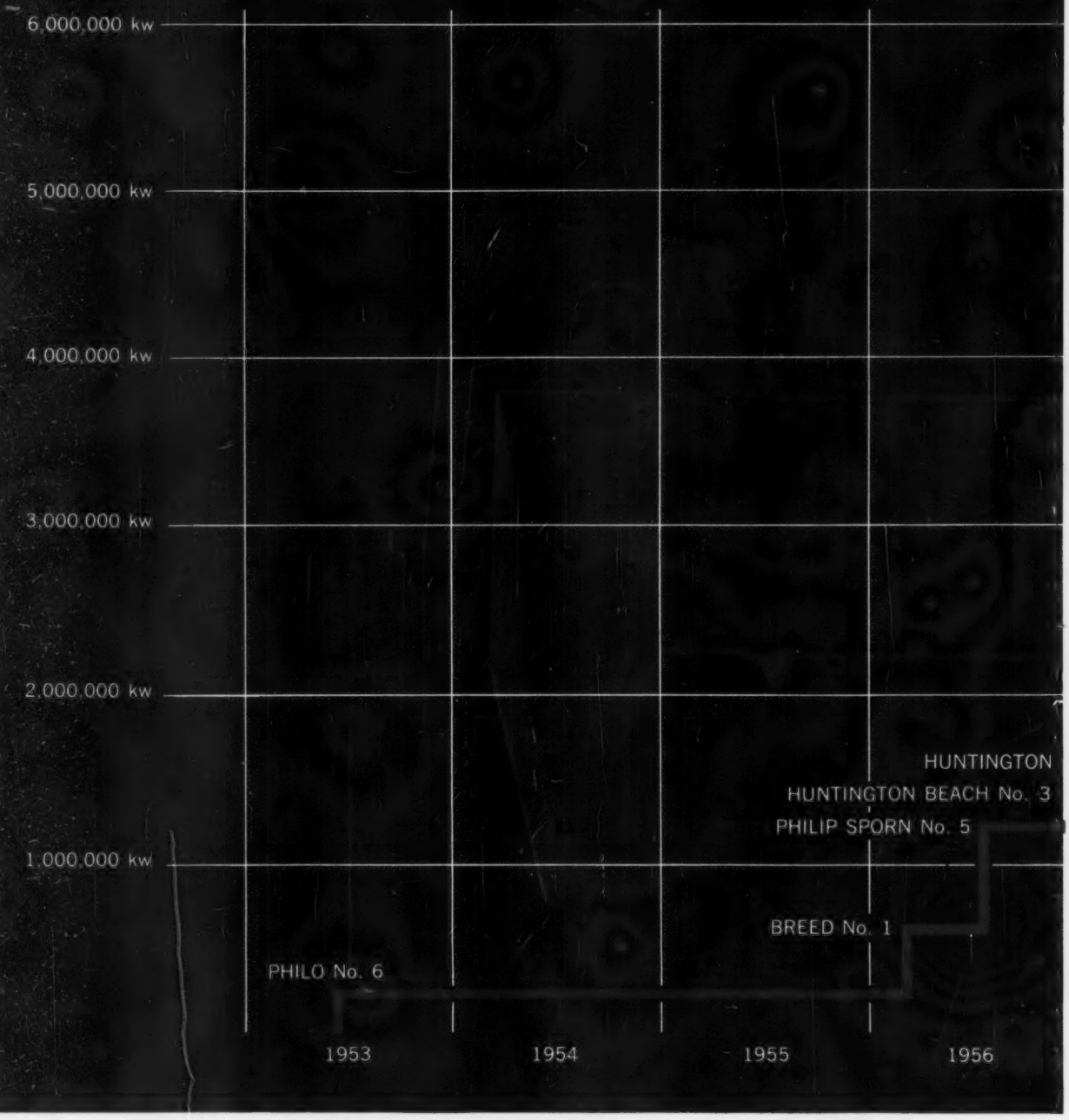
ECONOMICAL HEAVY DUTY V-8's with 292-, 302- and 332-cu. in. displacement give you tailored-to-the-job economy at much lower prices than you would expect in trucks with engines of this size. Stress-relieved cylinder heads, aluminum alloy pistons and sodium-cooled exhaust valves are but a few of the heavy-duty features you get with these engines.

ECONOLINE — ALL-ROUND ECONOMY LEADER — and low price is only the start! Certified tests show this pickup may save $100 on gas, oil, tires and license over your present conventional pickup every 16,000 miles you drive.

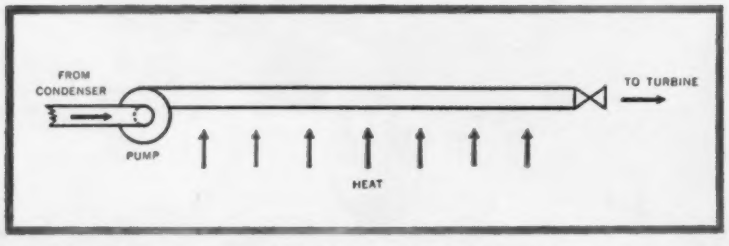
AMERICA'S MOST POPULAR VAN — and small wonder! Econoline savings start with a price far under any popular ½-ton conventional panel on the market! And they continue saving every day—certified tests have shown that in 16,000 miles, savings in operating costs compared to the conventional panel you may now own could top $100! Big 4-ft. doors rear and curbside plus 204 cu. ft. of loadspace, and a floor that's flat the full length, mean easy cargo handling.

PROVEN 262-CU. IN. BIG SIX FOR FORD MEDIUMS includes more heavy-duty engine features than any other Six of its size. Never before such long-term durability, reliability, and economy at so low a price.

PRODUCTS OF Ford MOTOR COMPANY



Acceptance for B&W Universal Pressure steam generator

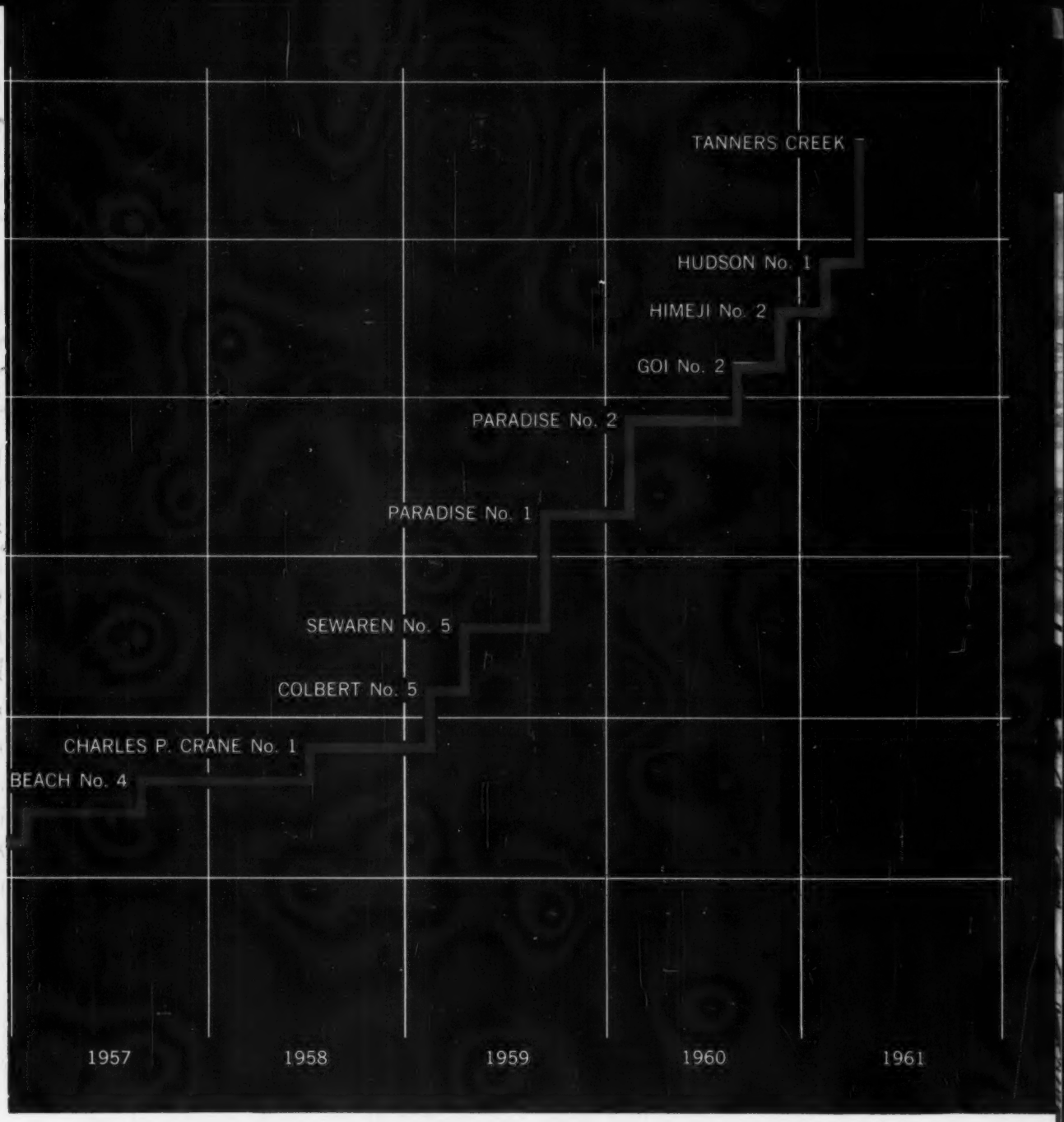


The Universal Pressure steam generator is a true once-through boiler. In effect, a long tube. Water enters at one end, picks up heat, changes to steam, becomes superheated and leaves the other end at the desired temperature and pressure.

Fourteen Universal Pressure steam generators are now installed or on order from Babcock & Wilcox. Five will operate at turbine throttle pressures of 3500 psi and higher. Nine are for operation at 2400 psi.

These 14 plants represent a three-quarter of a billion dollar investment by the utility industry.

What is behind the trend to the Universal Pressure boiler? There are four major reasons.



keeps growing. Orders now top 5,500,000 kw.

1. Increased availability. The Universal Pressure steam generator is a true once-through unit. Its inherent simplicity has resulted in 95 per cent boiler availabilities.

2. Increased economy. Ability to maintain steam temperatures over the entire load range improves the plant's overall efficiency. B&W's flexible by-pass system permits start-ups with minimum fuel and economical low-load operation.

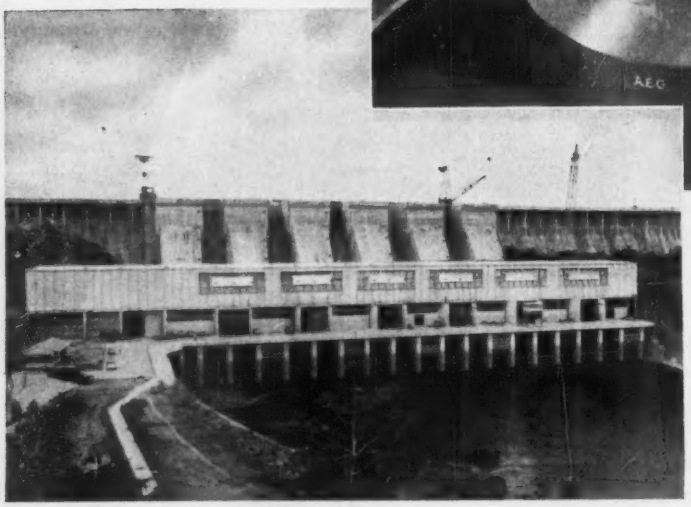
3. Lower maintenance costs. After trip-out, the Universal Pressure steam generator can be entered for maintenance in 2½ to 3 hours. Fast cold starts and hot restarts can be made without thermal shock to turbine parts or steam piping. The condensate polishing system provides maximum protection against boiler or turbine deposits. Gas conditioning minimizes superheater creep, corrosion, and slagging.

4. Reduced overall plant capital costs. A Universal Pressure steam generator weighs approximately 20% less than a drum boiler. Foundations can be smaller and less expensive. Less steel is required. Erection is simpler and faster.

For more information write to: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

Babcock & Wilcox

One of the most important hydro-electric power stations



An interior view of the Caroní-Macagua machine hall

Caroní-Macagua dam and power station viewed from tailrace

One of the most important hydro-electric power stations is now under construction on the lower reaches of the Rio Caroní in Venezuela.

AEG

With its six 70 MVA, 116 rev/min AEG umbrella-type alternators it will furnish power for a vital industrial centre being developed in an area rich in resources.

8917 •

ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

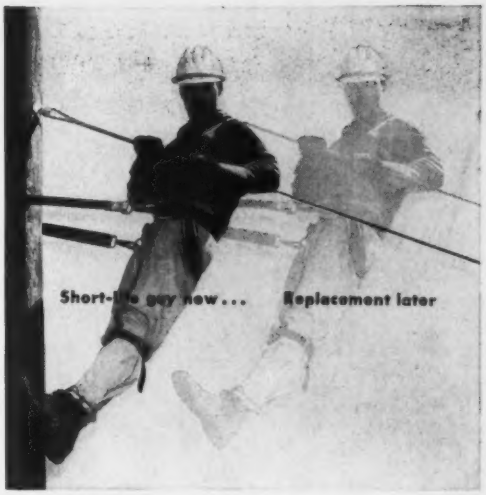
Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

Are you paying for

TWO GUYS

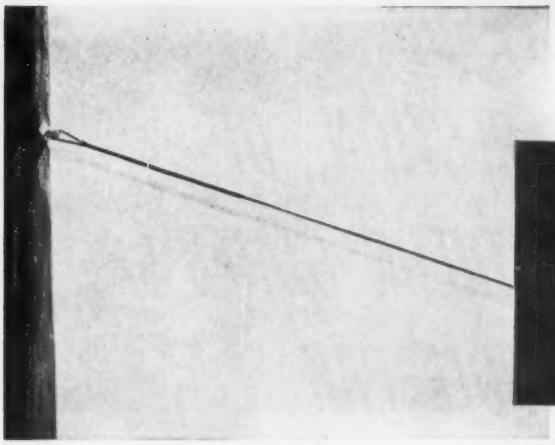
During the life of

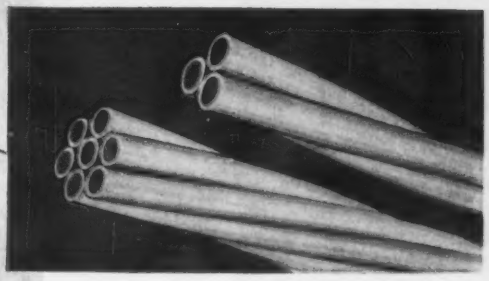
ONE POLE?



INSTALL **ALUMOWELD®** STRAND ONCE

and eliminate replacement costs





There's no built-in replacement cost to be paid later when you buy Alumoweld Guy Strand. Alumoweld matches the long life of modern poles, as a guy strand should. It stays up and retains its strength, unimpaired by years of exposure to the elements, because an *extra-thick* aluminum covering (25% by area) protects the steel core from rusting.

Size for size, Alumoweld Guy Strand has the same tensile strength as extra-high-strength steel . . . weighs less . . . is easier to install . . . and will last far longer.

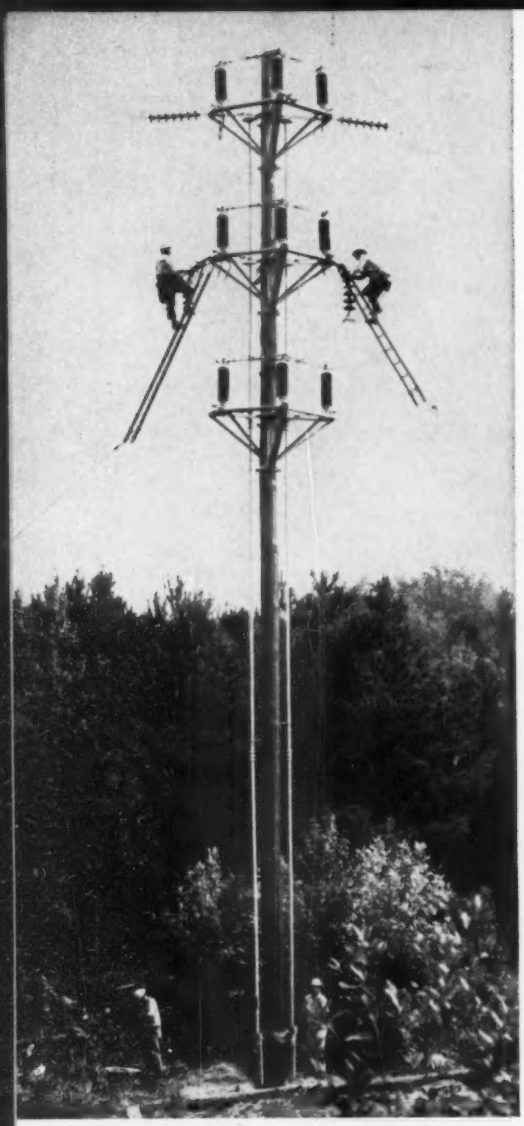
Why pay for two guys during the life of one pole when one Alumoweld Guy will do the job and save you money and trouble? For your convenience, stocks of Alumoweld Strand are available for immediate shipment from our warehouses in New York, Chicago, Pittsburgh and Memphis.

COPPERWELD STEEL COMPANY WIRE AND CABLE DIVISION, GLASSPORT, PA.

For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

Canadian Distributor: NORTHERN ELECTRIC COMPANY LIMITED

ALUMOWELD **GUY STRAND**



MINIMUM CREW TIME is needed to install Southern States Pole-Pak Air Switches. One pole is all that's needed for three-way switching, compared with conventional arrangements requiring up to six poles. Limited land requirements offer opportunities for installations where other types are not possible. Savings can be substantial.

EXCLUSIVE MOUNTING SYSTEM SPEEDS ERECTION OF SOUTHERN STATES' POLE-PAK

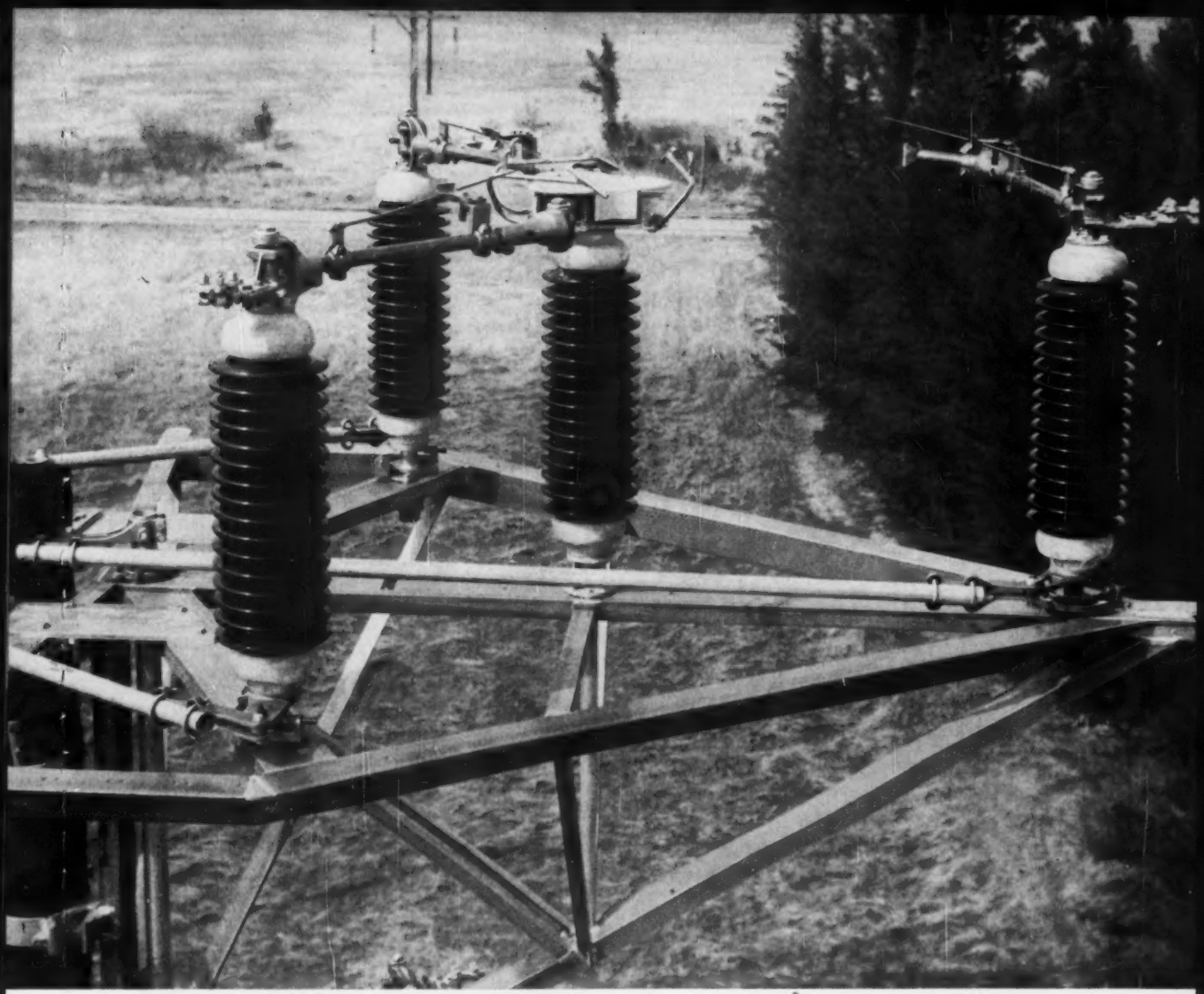
There are many outstanding mechanical and operating features of Southern States Pole-Pak phase-over-phase air switches. But the speed and ease of installation are particularly outstanding advantages.

Southern States employs an exclusive, simplified mounting system. Clamp-type steel bands are fastened to the pole at pre-determined positions. No gaining or drilling is necessary, assuring longer pole life. All switch units are assembled on the ground and hoisted into position. Hooks on the switch frame slip over a mounting plate on the top band, providing temporary suspension and automatically lining up mounting holes for quick and easy permanent bolting. It's that simple!

Other Pole-Pak Features

The Pole-Pak uses Southern States Type 57L braidless air switches. These rugged switches are equipped with Amplitact® contacts, time-proved as the most dependable means devised for handling high short currents.

The Southern States 57L switch is unusually easy to operate. Its blade is designed to toggle into the closed position and has no tendency to open. No force from the operating mechanism is needed to keep the switch closed. The switch is easily oper-



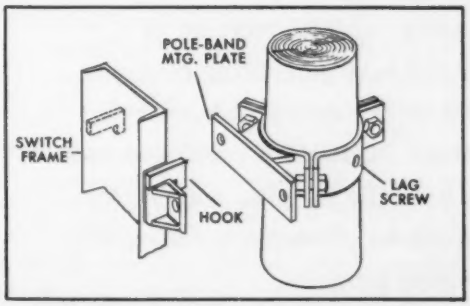
SOUTHERN STATES POLE-PAK is available in voltage ratings from 7.2 kv through 69 kv and continuous current ratings of 600 and 1200 amperes. One- two- or three-way models are available. Southern States Type 57L side-break braidless air switches with Amplitact® contacts are used in the Pole-Pak.

ated by one man, even under icing conditions.

The Pole-Pak frame is constructed of 6061-T6 structural aluminum with adequate bracing for vertical angular pulls in addition to line tensions.

This phase-over-phase method of switching, employing only one pole, with its many time-saving and cost-saving advantages, warrants careful consideration.

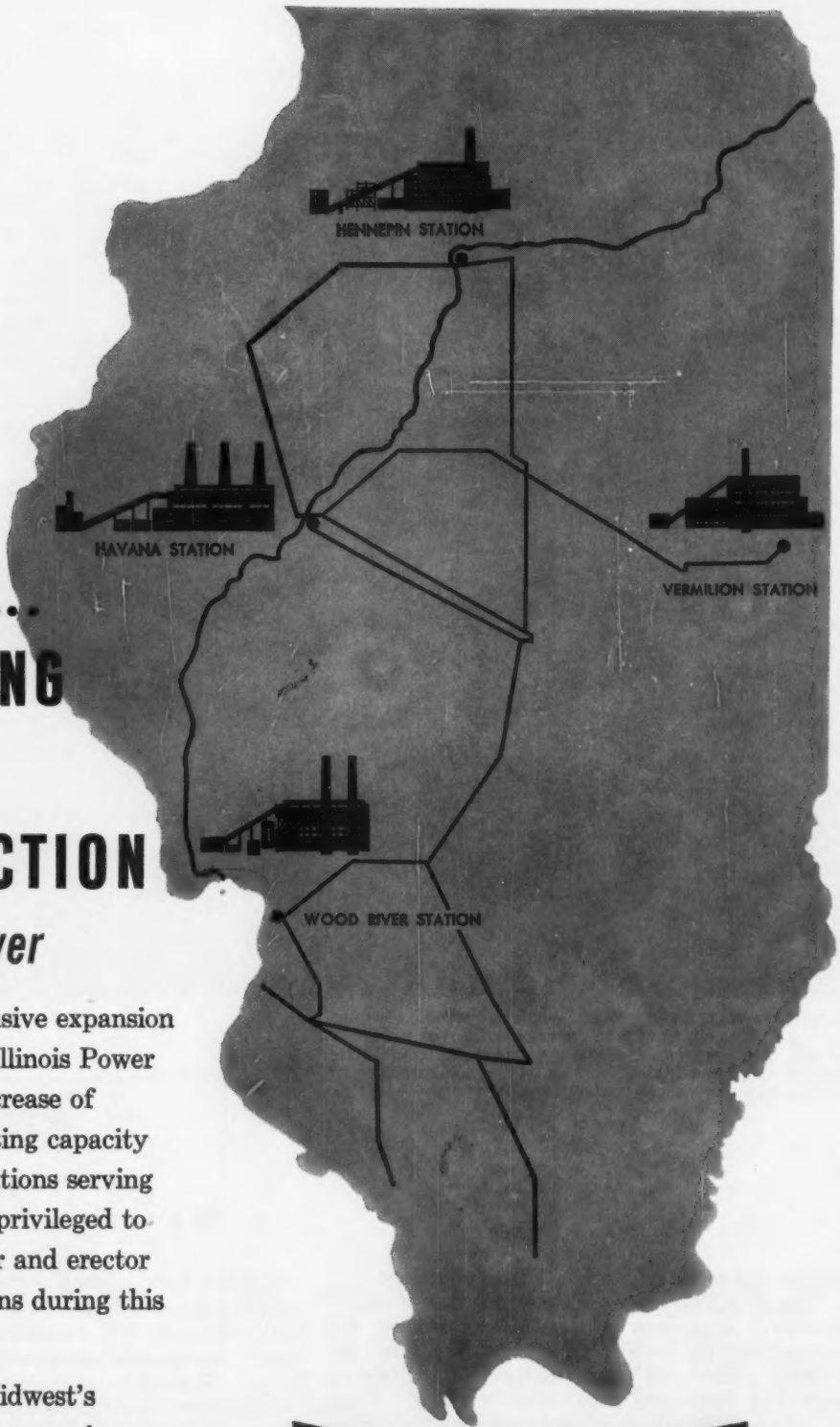
Get full information from your Southern States representative, or write for Bulletin 61 PP.



SIMPLIFIED MOUNTING results from exclusive system. Steel band is clamped to pole. Two lag screws prevent slipping. Hooks on switch frame slip over pole-band mounting plate. No drilling or gaining of pole is necessary.

SOUTHERN STATES
HAMPTON, GEORGIA

IN CANADA: DOMINION CUTOUT CO., LTD., TORONTO



14 YEARS... CONTINUING PIPING CONSTRUCTION

for Illinois Power

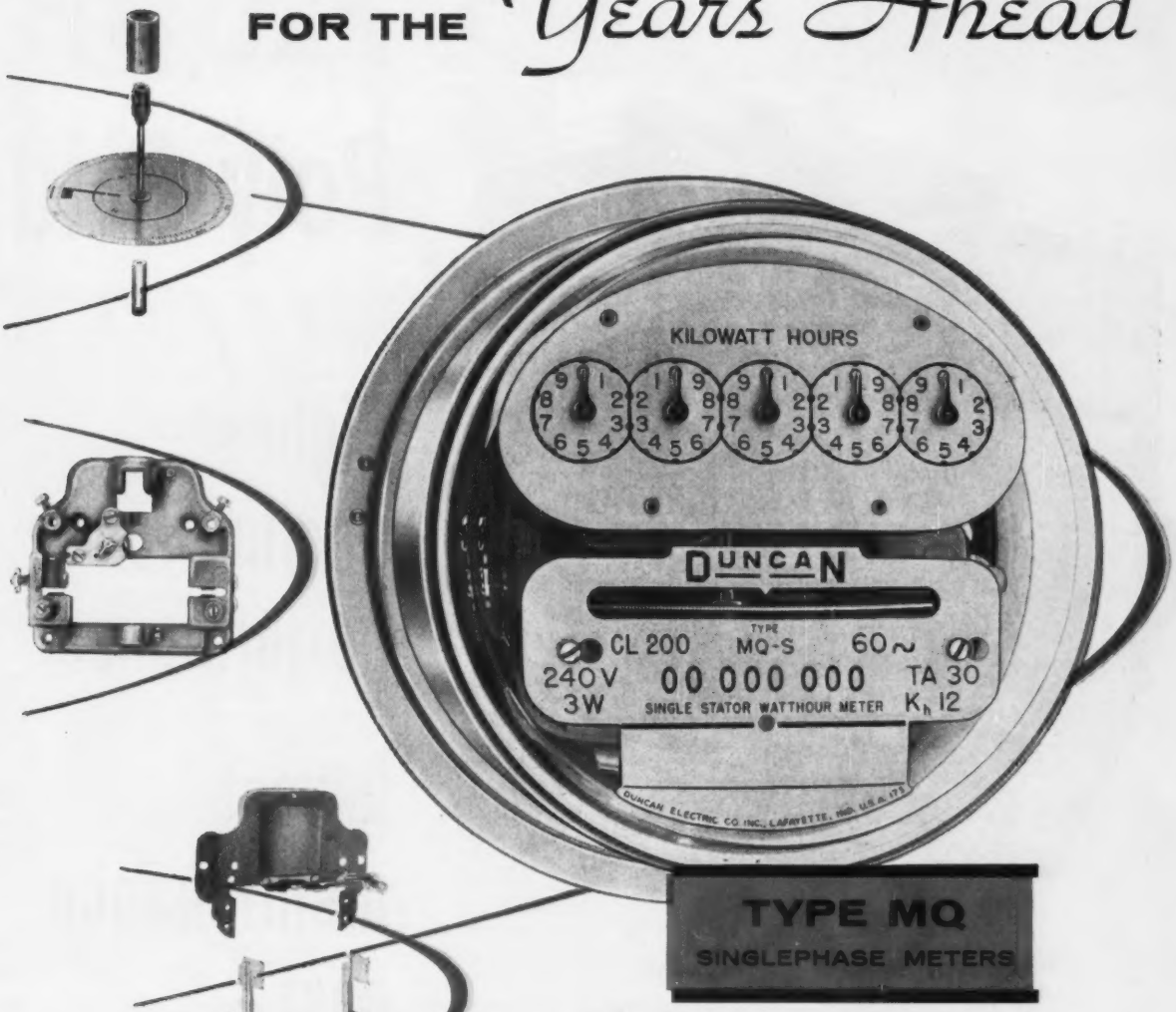
A 14-year era of extensive expansion has been enjoyed by Illinois Power Company, with an increase of 1,092,000 KW generating capacity shared by the four stations serving the state. Midwest is privileged to have been the supplier and erector of piping for all stations during this expansion program.

For information on Midwest's complete piping erection services for power stations and industrial processing plants, write today for 24-page illustrated brochure POWER AND PROCESS PIPING. 6119

MIDWEST PIPING

A Division of Crane Co. 1450 South Second St. • St. Louis 4, Missouri

FOR THE *Years Ahead*



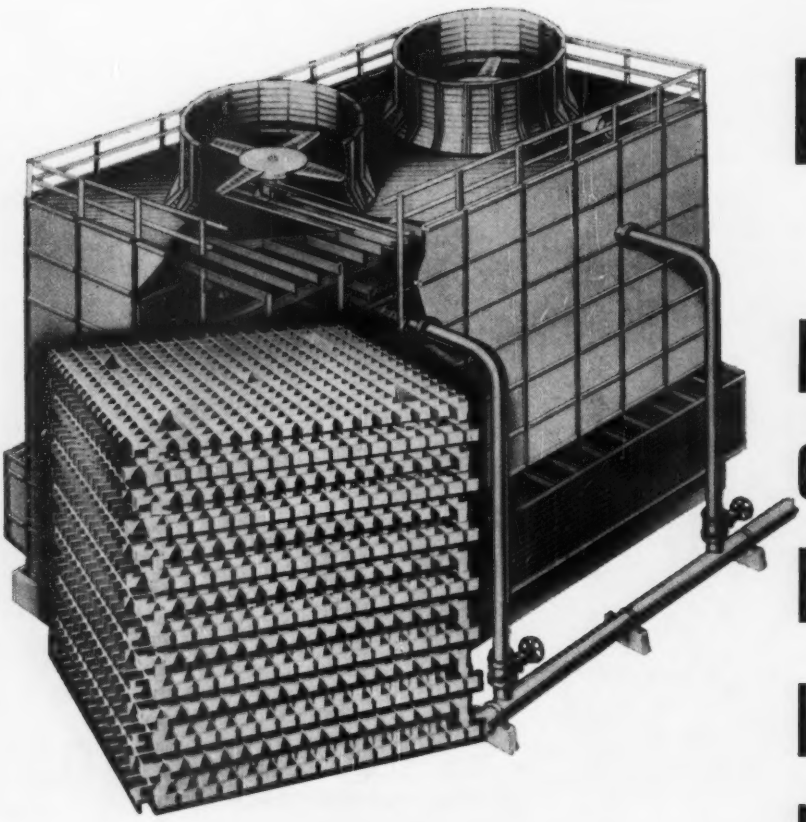
Building a *truly better* watthour meter is a goal that might seem impossible in accomplishment when compared with standards already attained. With careful deliberation and decision, Duncan has achieved this end in the TYPE MQ meter, now in full production in all Classes—10, 100 and 200.

The meter incorporates Duncan's shielded top magnetic bearing. The new design also provides for front removal of the rotor through new positioning of high energy, surge-resistant Alnico damping magnets. Positive end play control of rotor . . . separable electromagnets . . . simplified assembly and adjustment are "user approved" features. *Let us give you the complete story.*

"Thinking Ahead . . . Moving Ahead
. . . to stay Ahead of Demand"

WATTHOUR METERS • MOUNTING DEVICES • DEMAND METERS

FLUOR
Poly-Grid



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lowest maintenance cost

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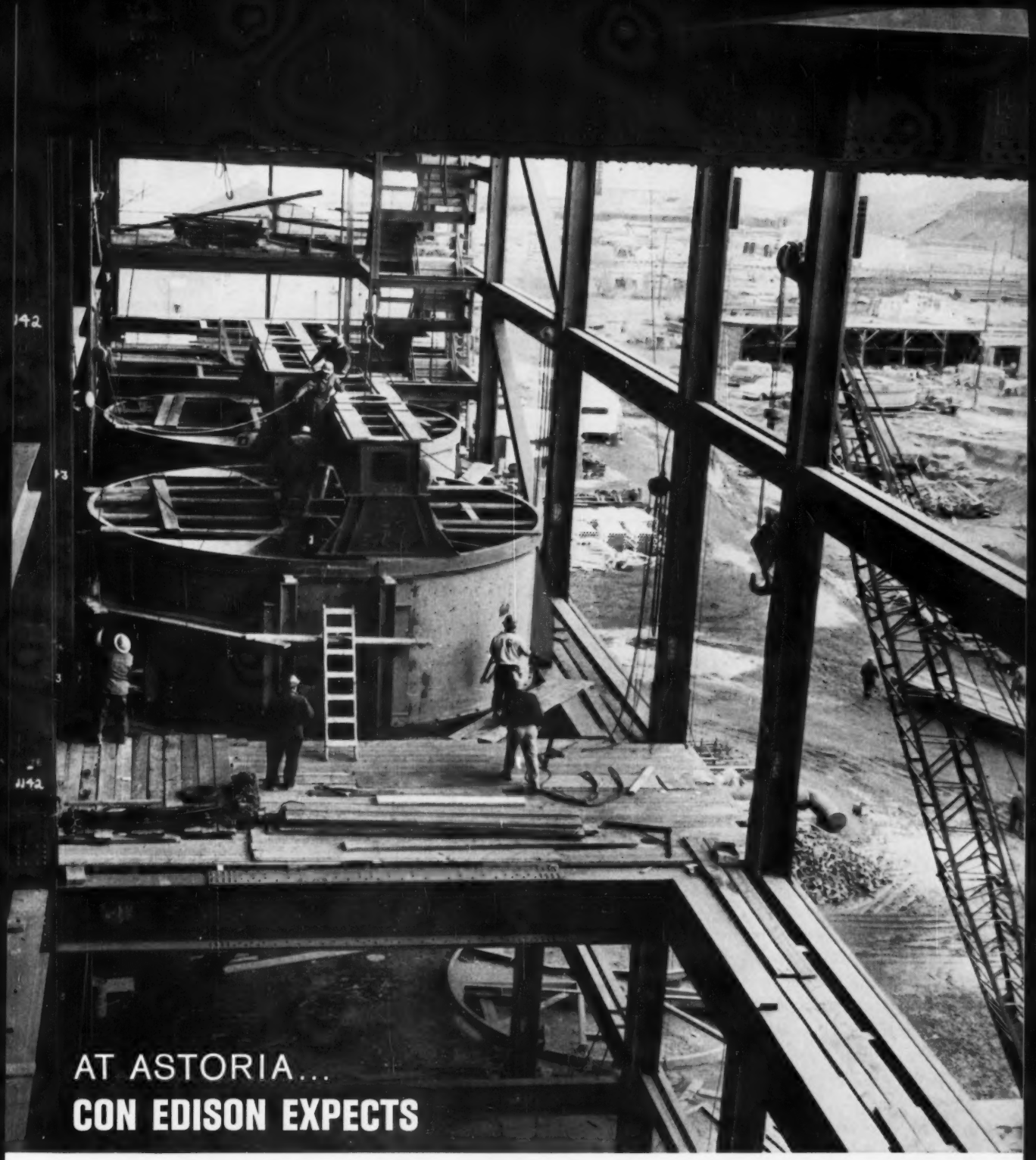
* Fluor high impact polystyrene and linear polyethylene Poly-Grids provide more cooling per cubic foot, less maintenance, and longer service life than any other cooling tower fill now in use.

Let us put a test grid in your cooling tower. See for yourself. Write:

Fluor PRODUCTS COMPANY **COOLING TOWERS**

A division of The FLUOR CORPORATION, Ltd.

GENERAL OFFICES:
P. O. Box 1267-A
SANTA ROSA, CALIFORNIA



AT ASTORIA...

CON EDISON EXPECTS

FUEL SAVINGS OF 8% FROM FOUR NEW LJUNGSTROMS®

Four new Ljungstrom Air Preheaters are being installed by Consolidated Edison Company of New York, Inc., on their Astoria Stations' #50 boiler unit. With a total heating surface of about 547,000 sq. ft., these four units are designed to reduce the stack temperature 345° F. By transferring this heat to the incoming combustion air, a fuel savings of about 8% is realized. Addition of these units makes a total of 16 Ljungstroms installed at Astoria . . . 77 either installed or on order in the entire Con Edison system.

Our engineers will be glad to recommend ways to improve your operating results on new or existing fuel fired units. For information, please write to:

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N.Y.

Plants grow better beside water

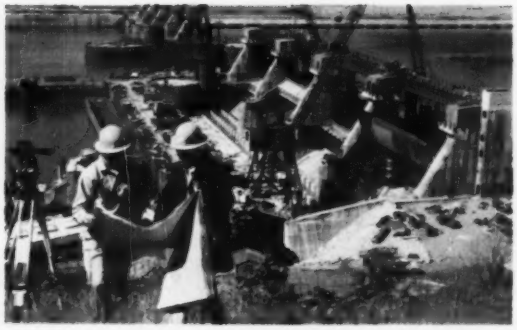
That's because an abundance of water is necessary for plant life. And those that have their roots at the water's edge can devote full attention to the problems of productivity.

Since 1953, more than 3,000 new plants have located on the Mississippi River System alone, not to mention the Great Lakes, the Gulf and numerous other rivers. Why? Mostly it is a matter of the "cost of living." Process water and plant utilities can be obtained economically; raw materials and finished products can be moved in and out at low cost.

If you are considering a waterside location, or plan to expand or modernize an existing plant, you are invited to call on Dravo's 60 years' experience in and around water. Work has been performed for the U.S. Army Corps of Engineers in every one of the past 60 years, including many lock and dam projects in the continuing program for improvement of the country's inland waterways system. Another activity is production and marketing of river sand and gravel. Hundreds of industrial plants are served by Dravo-built docks. Ships and barges laden with ore, coal, bauxite and other bulk cargo are unloaded by Dravo materials handling equipment.

Pumphouses and water intakes, water and waste treatment facilities, steam or power generating plants, fabricated piping are also company specialties. Towboats, tugboats and barges launched at the Pittsburgh or Wilmington shipyards move almost every type of water-borne commodity. A subsidiary, Union Barge Line, offers common-carrier and contract transportation service on the Mississippi River System and Gulf Intracoastal Waterway.

The coupon can be used to obtain more information on these activities.



Marine construction experience includes giant dam and lock projects—commercial installations of all kinds.

Twin high-speed river towboats built for a New Orleans transportation company.

A Union Barge Line tow carries products of many industries.

Generating station, dock and unloader built on turn-key basis.

A covered hopper barge is launched at Neville Island shipyard.

Dravo Corporation, 4790 Grand Avenue, Pittsburgh 25, Pa.

Please send me information on the following products and services:

- ☐ Pumping Stations & Intakes
- ☐ Sewage & Water Treatment
- ☐ Coal & Ore Unloaders
- ☐ River Transportation
- ☐ Sintering & Pelletizing Plants
- ☐ Docks, Harbors, Foundations
- ☐ Oxygen Steelmaking
- ☐ Ore Bridges
- ☐ Shafts, Slopes
- ☐ Grating
- ☐ Space Heaters
- ☐ Oxygen Plants
- ☐ Steam & Power Plants
- ☐ Towboats & Barges
- ☐ Fabricated Piping
- ☐ Container Cranes
- ☐ Compressor Stations
- ☐ Process Machinery

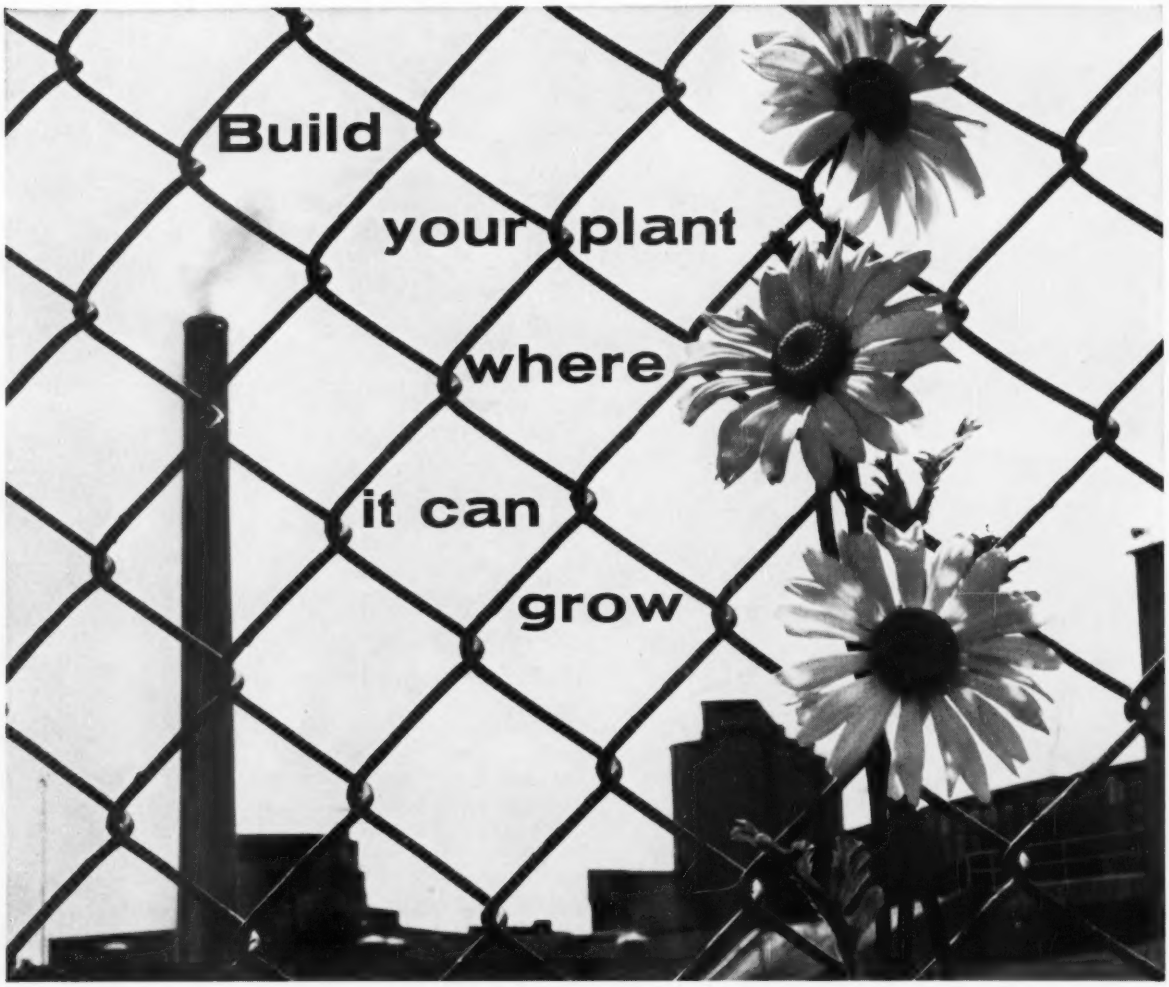
Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

DRAVO



Select A Site Near PEABODY'S Two-Billion-Ton Coal Reserves For Economical Power Far Into The Future

When you select a new plant site, plan for long-range growth by locating near Peabody's two-billion-ton coal reserves and modern mines . . . served by economical water transportation and major trunkline railroads . . . offering favorable shipping rates for raw materials and finished products.

Peabody's big, fully mechanized mines and tremendous reserves assure low-cost power for your plant and long-range insurance for your investment in capital equipment. Let Peabody help you select your new plant site . . . a site where *your* business can *grow*.

Learn more about the location of Peabody's 25 modern mines and river dock loading facilities. Write Industrial Development Division, Department EW.

power for progress

PEABODY COAL COMPANY

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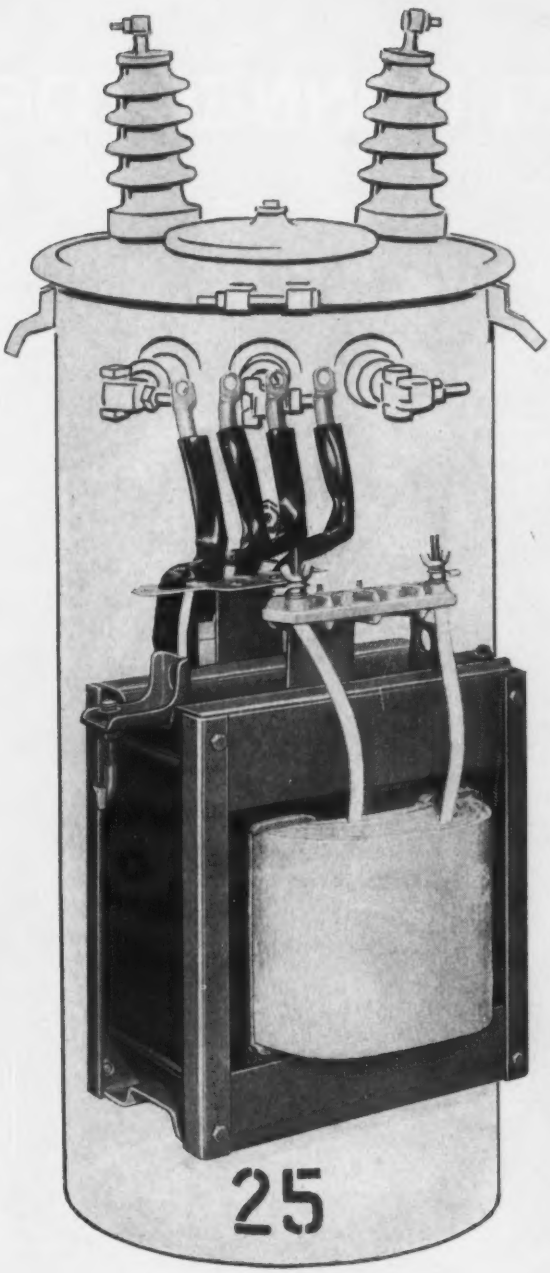
Offices In: CHICAGO, COLUMBUS, DES MOINES, DETROIT, INDIANAPOLIS, KANSAS CITY, LOUISVILLE, MADISON, WIS., MEMPHIS, MINNEAPOLIS



Central's "7000" Series Distribution Transformer with DURA-PAK Core and Coil has a 2.5 to 1 Copper-to-Core Loss Ratio!

LOWER TOTAL LOSSES

DURA-PAK features lower copper losses, lower total losses, lower impedance and better regulation (especially during peak load conditions) to give the utility LOWER OPERATING COSTS, INCREASED LOAD REVENUES and FEWER CHANGE OUTS.

DURA-PAK'S new insulation system, with 130°C Heavy Epoxy insulation on both high and low voltage conductors, provides MORE OVERLOAD CAPACITY without loss of transformer life. Epoxy insulation shows no hydrolysis and actually contributes to the chemical stability of DURA-PAK's insulation system.

DURA-PAK's rugged, compact construction, plus a special thermo-setting bonding agent, assures INCREASED SHORT CIRCUIT STRENGTH.

Central's constant emphasis on QUALITY led to the design of the DURA-PAK Core and Coil Assembly in which a 2.5 to 1 copper-to-core loss ratio has been achieved—*with no appreciable increase in core loss.* It was this same emphasis on QUALITY which led to the completely new overall design of Central's "7000" Series Distribution Transformer—the transformer with COORDINATED E-T-M* FACTORS.

**Electrical-Thermal-Mechanical*

CENTRAL CTC

Sales Offices in Principal Cities

Transformer Corporation

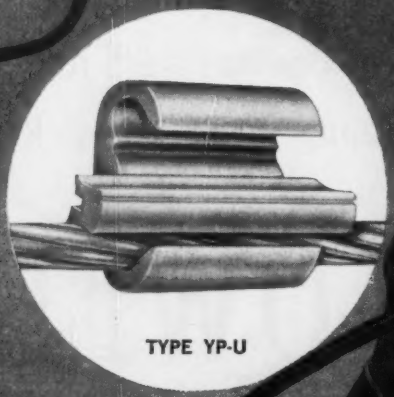
Telephone JEfferson 4-5332

PINE BLUFF, ARKANSAS

Plants at Pine Bluff, Arkansas, and Arcadia, Florida

NEMA

FEWER, BETTER CONNECTORS



TYPE YP-U

NEW

universal
compression tap
connectors cover
complete conductor
range with
40% fewer sizes

CABELOK™ CRIMPIT®— ONLY TAP CONNECTOR WITH ADJUSTABLE SPACER

Ask your Burndy representative for a demonstration. See how simple CABELOK CRIMPIT is to install . . . it's adjustable spacer can lock on tap or run or when properly positioned — will retain both.

BURNDY

HYTOOL® TYPE MD6 installs all types of overhead connectors — including INSULINK® and LINKIT® service entrance connectors as well as CABELOK CRIMPIT and full-tension HYSPLICE® on overhead line conductors from #6 thru 4/0.

SIMPLE DIE CHANGE — Die recess is also a crimping groove — only one die for entire CABELOK CRIMPIT range. Dies snap in easily . . . lock positively.

NORWALK, CONNECT. BICC-BURNDY Ltd. Prescot, Lancs., England. In Europe: Malines, Belgium. **TORONTO, CANADA**

61-22

C1534 FLEETSIDE PICKUP ▲

C1504 STEPSIDE PICKUP ▲

R1254 RAMPSIDE PICKUP ▼

K1534 4-WHEEL-DRIVE FLEETSIDE PICKUP ▲

C1416 CARRYALL ▼

FROM CHEVROLET'S NEW WORLD OF WORTH!

JOB-MATCHED CHEVROLET TRUCKS FOR '62

NEW POWER! NEW EYE APPEAL! CHEVIES FOR EVERY CHORE

From Chevrolet's broader-than-ever 1962 lineup of trucks for every kind of hauling job comes a full roster of better-than-ever light-duty models, specialists at trimming tough jobs down to size in short order. Here are new models and new power choices to meet a wider range of working needs, plus a trim new look for all conventional models that gives you safer seeing down the road! Now it's easier than ever to get Chevrolet's traditional thrift and dependability going for you, in the model tailor-made for your kind of job. There are work-loving pickups in a full range of sizes and weight ratings, in sleek Fleetside and handy Stepside styles, plus sensational Corvair 95 Rampside and Loadside models built to outwork anything in their class. In addition, there's the biggest choice ever of *choice* delivery models, including smart, fleet-stepping panels, high-capacity Step-Vans for every job up to 10,000 lbs. GVW, and the wonder-working Corvair 95 Corvan. For specialized requirements there are sturdy stake models and chassis-cabs in every size and weight class, rounding out a selection sure to include a better way to do *your* job! Why not see your nearby Chevrolet dealer for full details on the model made for you, and start finding out right away how much better business can be. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

NEW EASY-VIEW STYLING—For 1962, all conventional pickups, panels and Suburban Carryall models ride in with trim new look-ahead lines, featuring a new hood design sloping lower at the front to let you see the ground as much as 8½ feet closer. Safer, easier viewing results! Also, there's a handsome new grille, new custom exterior trim, and sparkling new colors. Inside, too, things are looking better for the man at the wheel, with new easy-to-live-with colors and tough good-looking upholstery.

NEW STEP-VAN 7—Here's good news—211 cubic feet of it!—for light-duty delivery operators with high-bulk lading problems. And Chevrolet's new Step-Van 7 is built to give your bulky loads a better ride, too, on the years-ahead Independent Front Suspension chassis design that's revolutionized the conventional truck field. With the big-saving High Torque 235 Six under the engine box, there's plenty of power to take your tightest schedules in stride, and a long list of better built body features adds up to easy work and extra-long working life.

NEW HIGH TORQUE POWER—New wider power choice for '62 lets you match your job needs better than ever, in all conventional pickup, panel and Carryall models. There's the standard-equipment 235 Six, cornerstone of the Chevrolet reputation for unbeatable operating economy, and the spirited, ultra-efficient 283 V8 for premium payload punch. *And now, in addition, the heavy-duty 261 Six is available at nominal extra cost, offering an extra measure of stamina and durability to keep on delivering in the roughest, toughest kind of duty.*

JOB-TESTED CORVAIR 95's—They've got a year of enthusiastic acceptance behind them and they're still the talk of light-duty trucking! Chevrolet's sensational Corvair 95 models, in two pickup styles and the spacious Corvan, have set new standards for space and weight utilization in the half-ton field. With a roomy driver compartment up forward and the compact, perky 145 Six tucked under the load floor at the rear, the space between goes to work in a way conventional designs can't match. And, to top it off, this new way to work comes in as pretty a package as ever came down the pike!

YOURS FOR THE ASKING . . . FREE INFORMATION

Use this convenient ordering coupon to get descriptive literature and specifications on new 1962 Chevrolet trucks to match your job. Just check what you would like, fill in your business address and mail to: Chevrolet Motor Division, P.O. Box 7271, Detroit 2, Michigan.

Please send:
1. Full-Line Brochure..... ☐
2. Corvair 95 Models..... ☐
3. Pickups & Light-Duty.. ☐
5. Suburban Carryalls.... ☐
6. 4-Wheel-Drive Models.. ☐
7. Medium- & Heavy-Duty Models..... ☐
8. Diesel-Powered Models. ☐
9. Tandem Axle Models... ☐

72

Name
Title
Company
Address
City Zone
County State

1962 CHEVROLET JOBMASTER TRUCKS

CHEVROLET

LOOK AT WHAT USERS SAY ABOUT L&N COMPUTERS

System operators who have been using the initial eight L&N solid-state economic dispatch computers for 18 months or longer were asked to rate their machines as either "Excellent" "Good" "Fair" or "Poor" in five respects. Look at the results:

	1	2	3	4	5	6	7	8	TOTALS
1. In view of our original expectations regarding fuel savings and overall effectiveness in handling system regulation, we rate the performance of this computer as:	E	G	E	G	G	E	G	E	4E 4G
2. Reliability of the computer to date has been:	E	E	G	G	G	E	G	E	4E 4G
3. From the standpoint of the operator's convenience, we rate the Desired Generation Computer as:	G	G	E	G	E	E	E	E	5E 3G
4. The readouts, setters and X-Y plotter (if any) are features which we consider:	E	G	E	F	G	*	E	E	4E 2G 1F
5. Installation of the computer, and subsequent check-out procedures were handled in a way which we consider:	E	E	G	E	G	G	E	E	5E 3G
									22E 16G 1F

**Not applicable*

Note that this report encompasses users' reactions to *all* L&N dispatch computers which have been operating for eighteen months or longer. There are no skeletons in this closet.

In addition to these installations, L&N has five computer systems now going into service (with another seven analog and digital machines in production) as well as fifty modern, Area-Type Control Systems operating in major control centers.

When you make your decision regarding a computer, data processing or control system, look at the results. Then talk with our Field Engineers. They consistently deliver systems that measure up to their owners' expectations. Leeds & Northrup, 4938 Stenton Avenue, Philadelphia 44, Penna.

LEEDS & NORTHRUP
Pioneers in Precision

"WHEN SO MUCH DEPENDS ON SO LITTLE . . IT PAYS TO RELY ON THE BEST"

to specify distribution transformers, then it's important you consider Moloney!

Why Moloney? Because Moloney's philosophy of "Total Design" gives your system the most dependable transformer available.

To give you the most for your transformer dollar, a transformer must have *several* established superior design and operating characteristics. Among these characteristics are low core loss . . . low copper loss . . . low impedence and exciting current . . . efficiently combined to obtain *total performance.*

The "Total Design" philosophy is Moloney's way of serving the industry's need for all-around superior performance, maxium dependability and minimum operating cost.

If it's your responsibility to select Distribution Transformer Suppliers, it's important you consider Moloney because of the "Total Design" philosophy which gives you the best purchase for your transformer dollar.

ME 61-21

MOLONEY ELECTRIC COMPANY

Manufacturers of Transformers and Switchgear for Utilities, Industry, and Electronic Applications

SILICONE NEWS from Dow Corning

5 tons of prevention

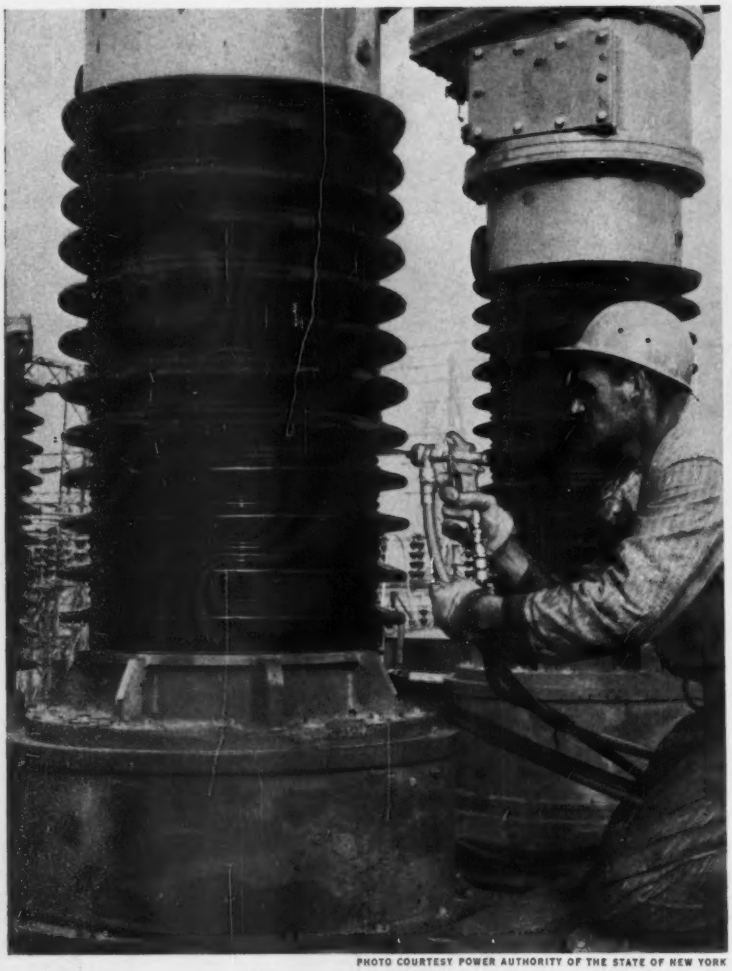


PHOTO COURTESY POWER AUTHORITY OF THE STATE OF NEW YORK

Spray-on silicone compound prevents leakage . . . flashover

Everything about the New York Power Authority's Niagara project is big. There is the world's largest switchyard funneling 2,190,000 kilowatts of generating capacity into industrialized western New York. And — to assure power continuity — the old "ounce of prevention" adage has been multiplied 160,000 fold.

Dow Corning 5 Compound — 160,000 ounces of it — has been applied to bushings and insulators to prevent leakage paths from forming . . . even during periods of high humidity and fog!

How silicones work. Air-borne particles that light on coated insulators are encapsulated by the silicone compound . . . isolated from each other . . . rendered moisture-free and nonconductive. *Result*: no flashovers or power leakages. Moisture becomes harmless "beads" on silicone coated insulators . . . can't wet contaminants to form continuous leakage paths. *Result*: fewer service interruptions.

How silicones save. Silicone coatings stretch the interval between scheduled outages . . . chop a tremendous slice from maintenance time and costs. One power company with a problem of cement dust contamination reports that three men in a scheduled outage of less than three hours can now do a cleanup job that previously required five men for two days. The old method: insulators were removed to the maintenance shop for hours of tedious scrubbing with steel wool and solvents. Now, used compound is wiped away easily with a dry rag and fresh Dow Corning 5 Compound applied by hand. Also, the interval between cleanups has been stretched by months.

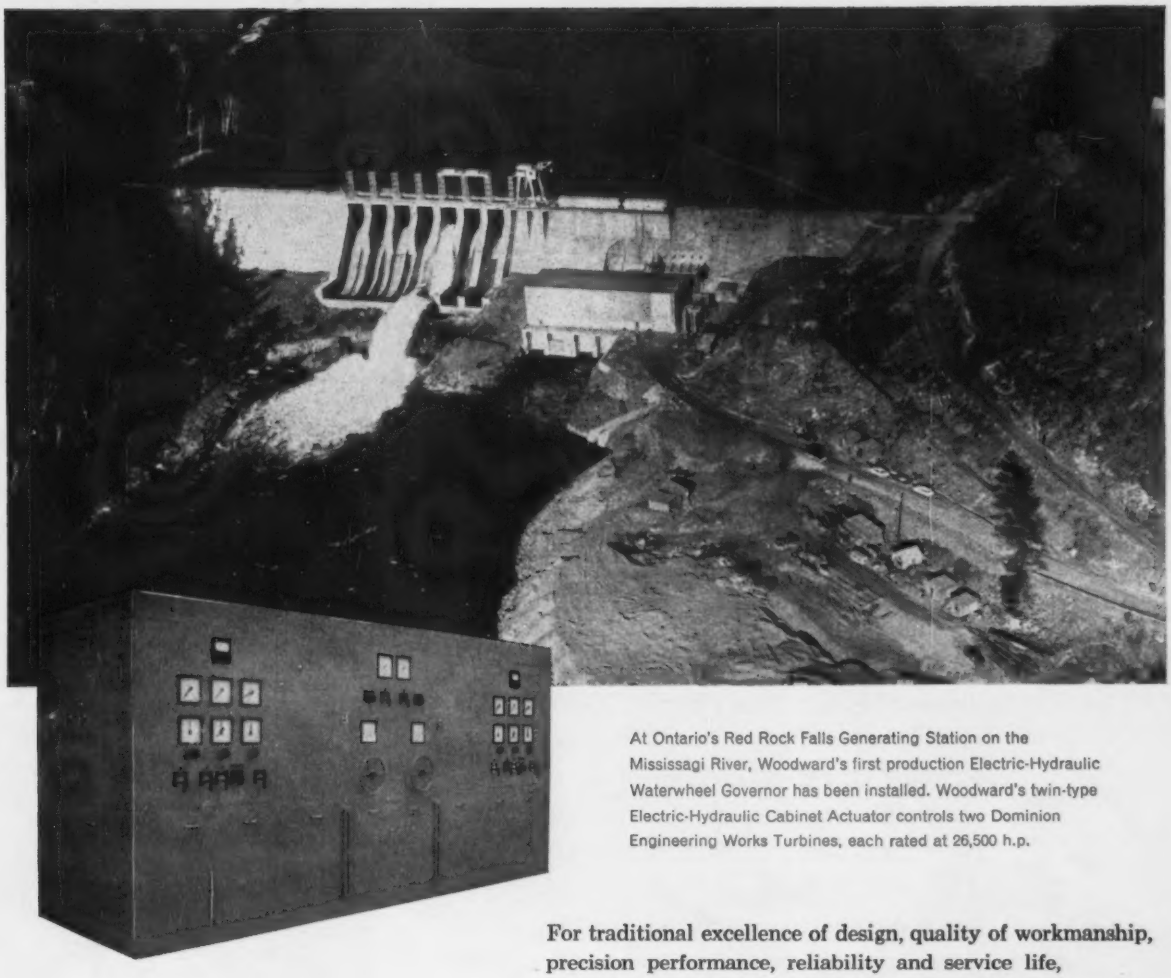
Another utility with a problem of salt spray now applies Dow Corning 5 Compound once a year. Previously, insulators had to be cleaned twice a month.

How about your installations?

Write today for complete information. Dow Corning Corporation, Midland, Michigan, Dept. 3922a.

first in silicones

Dow Corning



At Ontario's Red Rock Falls Generating Station on the Mississagi River, Woodward's first production Electric-Hydraulic Waterwheel Governor has been installed. Woodward's twin-type Electric-Hydraulic Cabinet Actuator controls two Dominion Engineering Works Turbines, each rated at 26,500 h.p.

DEBUT
at Red Rock Falls

Woodward introduces new Electric-Hydraulic Waterwheel Governor

For traditional excellence of design, quality of workmanship, precision performance, reliability and service life, Woodward Mechanical-Hydraulic Governors have long been the standard of the world. To these qualities are now added the simplicity and versatility of electric speed sensing with Woodward's new Electric-Hydraulic Cabinet Actuator. Such mechanical devices as the ballhead assembly and temporary droop dashpot are supplanted by static electrical components that offer advantages for certain plants — (1) continuous control signals can be used with particular benefit on fringe control, (2) greater flexibility in arrangement of equipment is possible because electrical controls can be remotely located from the distributor valve assembly, and (3) operating and maintenance personnel are already familiar with similar electrical equipment in other plant functions.

For the finest in prime mover control, always specify Woodward waterwheel governing equipment — either electric-hydraulic or mechanical-hydraulic.

"Worlds oldest and largest manufacturer of hydraulic governors exclusively"

WOODWARD SERVICE

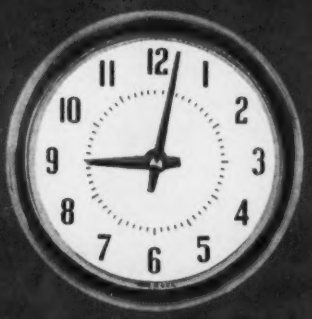
WOODWARD GOVERNOR COMPANY

ROCKFORD, ILLINOIS

Fort Collins, Colorado • Schiphol, The Netherlands • Slough, England • Tokyo, Japan

H-107

Westinghouse F/A motor completely disassembled in 90 minutes



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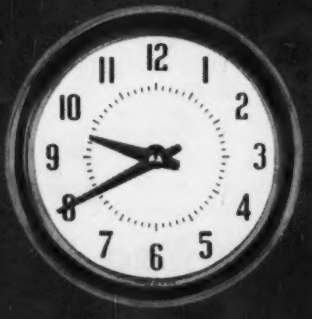

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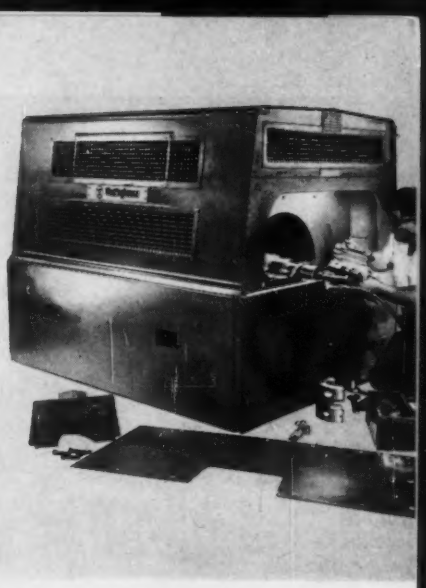
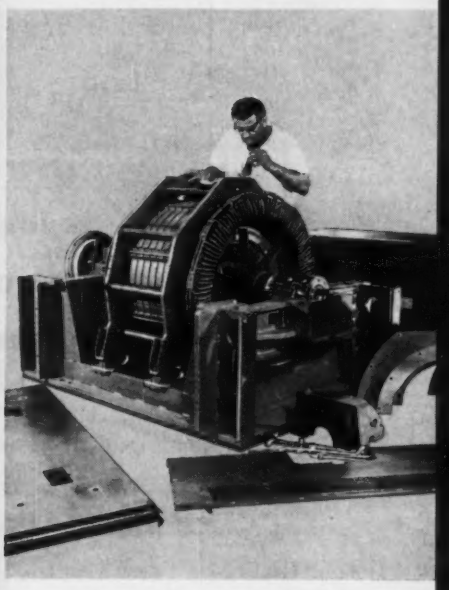
Only 90 minutes are required to completely disassemble the Westinghouse F/A (fully accessible) motor. After cleaning, inspecting and servicing, the F/A motor can be completely reassembled and returned to service in about two hours. One maintenance engineer reports that an F/A motor is serviced in his shop in about one-fourth the normal time for comparably rated motors. F/A motors are available in ratings from 250 hp/600 rpm to 7000 hp/3600 rpm. For more information, call your Westinghouse representative. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. *You can be sure . . . if it's Westinghouse.*

Motor stopped; disassembly begun.



Sufficiently disassembled to permit bearing inspection.

End covers, side panels, air shields removed. Winding inspection now possible.



Complete disassembly possible for major cleaning, inspection and servicing.

J-15023

Westinghouse

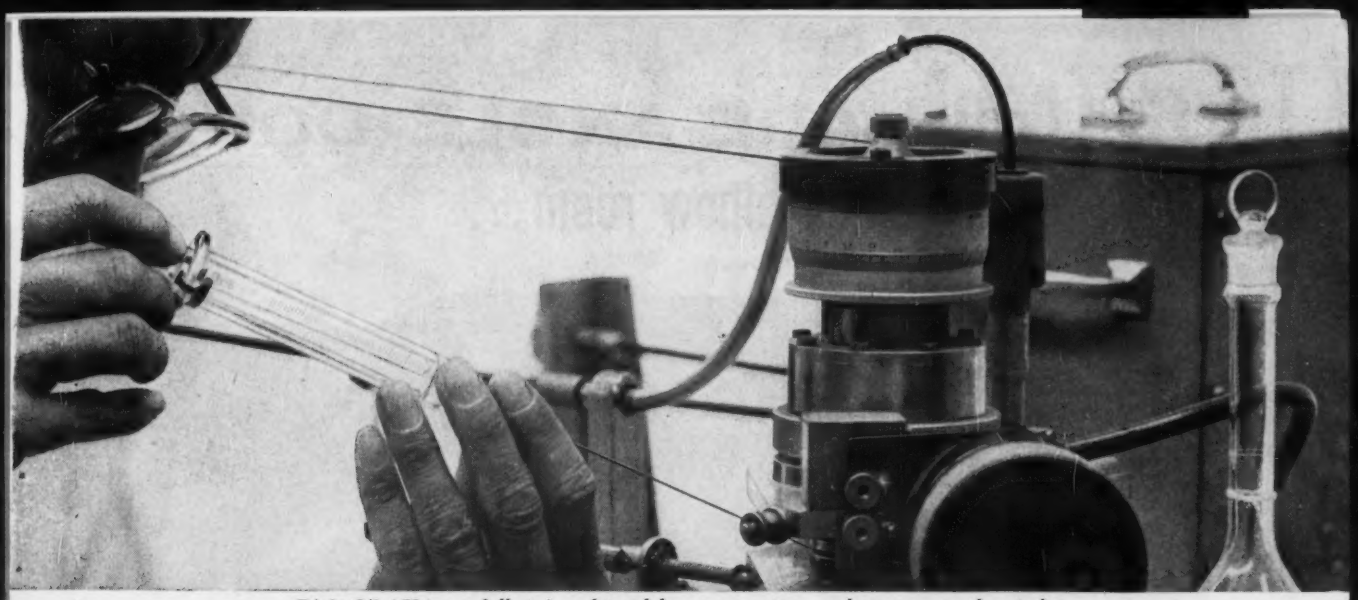
... and reassembled in just two hours

MARLEY is important in every picture of

PROGRESS, U.S.A.

Dynamic growth areas demand power . . . and economical conservation of cooling water in volume. At Agua Fria Station of Salt River Project, Phoenix, Arizona, Units Nos. 1 and 2 for five years have proved the practicality of big per cell capacity cooling towers teamed with big capacity turbines. A Marley Class 600 Double-Flow was recently supplied to furnish condensing water for the 168-mw Unit No. 3. It is the largest machine served by a single-structure cooling tower and, says T. M. Morong, Chief Engineer, "Tests indicate it is contributing to our having a plant that more than meets design criteria." It also contributes economy in required plant area, piping cost and maintenance.

THE MARLEY COMPANY • KANSAS CITY, MISSOURI



Diala Oil AX is carefully injected into laboratory equipment that measures electrical properties of the oil. This is one of the ways Shell makes sure that dielectric strength is high.

BULLETIN:

Shell reveals how Diala Oil AX lasts up to 5 times longer than ordinary oils

Only an oxidation-inhibited transformer oil of exceptional quality can be expected to give long service life under today's severe operating conditions.

That's why a growing number of utilities are switching to Shell Diala Oil AX. Read how Diala® AX helps them hold costs down—and how it can do the same for you.

THE DISTRIBUTION transformer is of constant concern to most utilities. It often operates outside its rated capacity during peak periods. Temperatures run high. And transformer maintenance costs are on the rise.

All of these factors have prompted utilities to search for a stable transformer oil that can help protect overloaded equipment, extend transformer life and reduce maintenance.

The answer for many utilities: Shell Diala Oil AX.

What Diala does

Diala AX contains a special Shell-developed oxidation inhibitor.

Accelerated laboratory oxidation tests show that Diala AX can provide satisfactory service *up to five times as long as* uninhibited oils.

Because of the oxidation inhibitor in Diala AX—and also because of Shell's selected base stocks and refining techniques—this remarkable transformer oil is exceptionally stable. It resists sludge formation. It helps prevent the creation of metal-attacking acids. And it reduces peroxide build-up which can damage many types of insulating materials.

Diala AX has also demonstrated an ability to extend the life of fabric insulation materials. In Shell's Emeryville, California laboratory, scientists soaked cotton insulating threads in many different oxidized oils—and for varying periods.

Conventional oils, when oxidized, weakened the thread by 25 to 40%. When subjected to the same oxidizing treatment, Diala AX had negligible effect on the thread's strength.

Diala AX has excellent dielectric properties (see photo above), good heat transfer characteristics and a very low pour point. Its low volatility reduces evaporation loss. And its flash point is high for maximum safety.

Call your Shell Representative

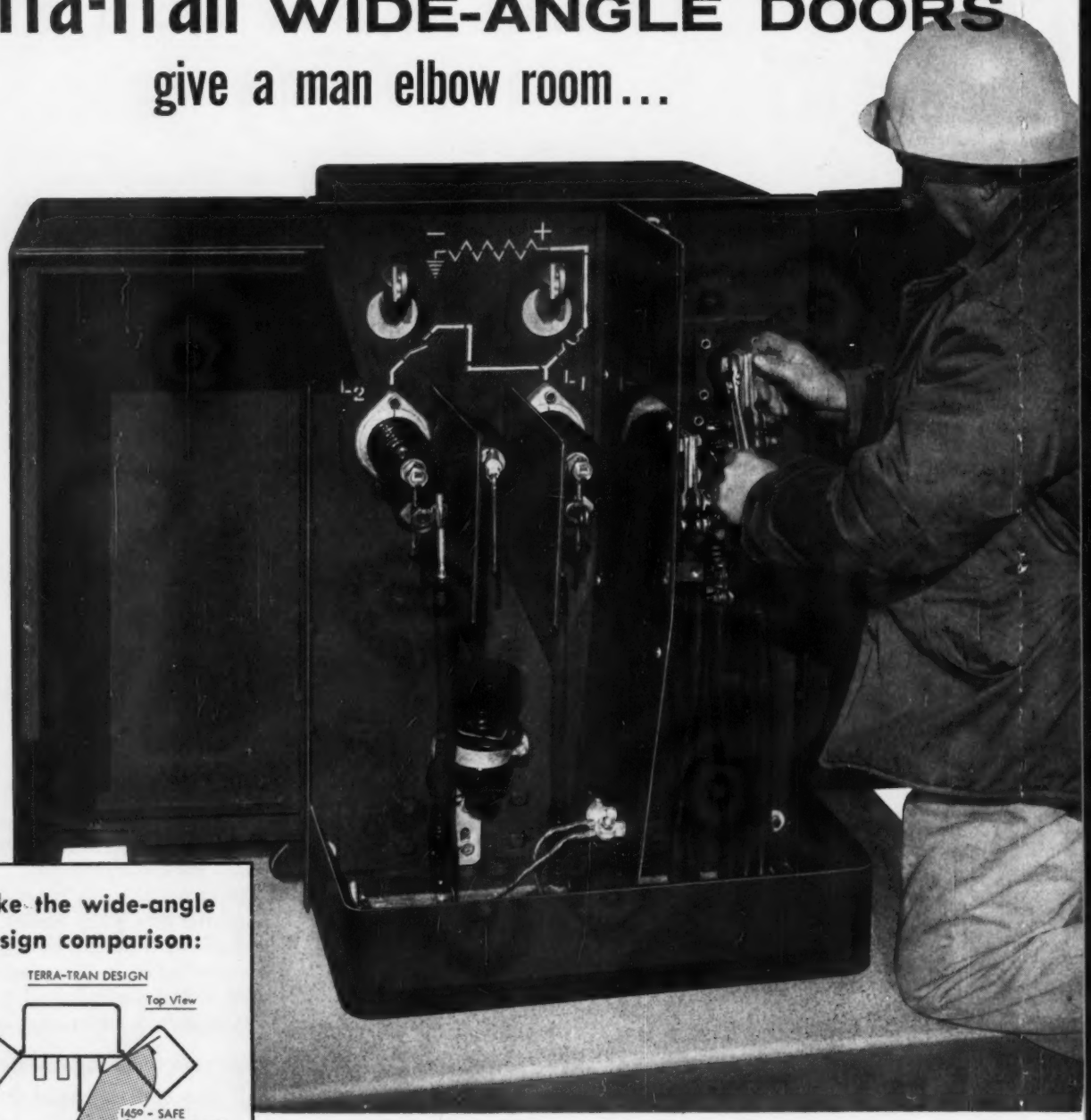
Ask your Shell Industrial Products Representative for all the facts on Diala AX. Or write: Shell Oil Company, 50 West 50th Street, New York 20, N.Y.

SHELL

A BULLETIN FROM SHELL
—where 1,997 scientists are working to provide better products for industry

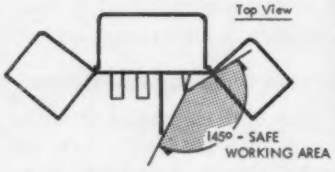
Terra-Tran® WIDE-ANGLE DOORS

give a man elbow room...



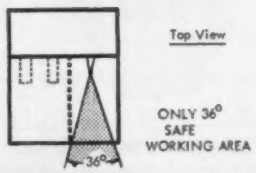
Make the wide-angle design comparison:

TERRA-TRAN DESIGN



Safe-working area with exclusive Terra-Tran wide-angle design.

SEPARABLE COMPARTMENT DESIGN



Safe-working area with typical separable compartment transformer.

RT&E Terra-Tran doors have 145° wide-angle design... 4 times more safe-working area for servicemen. Up-front, less than 12 inches away, primary and secondary terminations are within easy reach... no top or sides to box in the working area. In the Terra-Tran wide-angle design as many as 36 secondary leads can be hooked up with greater ease and safety because servicemen are not hampered by limited, tight, working space.

Changeout with Terra-Tran is simpler ... remove only 4 mounting bolts and slide away smaller Terra-Tran — slide in the new with the doors wide open. Remember Terra-Trans weigh much less, too.

RT&E builds a world of safety in the Terra-Tran

Only RT&E Terra-Trans have:

- 145° wide-angle door design
- 4 times more safe-working area
- No top or sides to hamper servicemen
- Up-front primary and secondary terminations within easy reach

Ask your RT&E Sales Representative for details or write for Bulletin 100 today.

RT&E CORPORATION

Waukesha, Wisconsin
Portland, Oregon
Arlington, Texas

Editorial Comment

OCTOBER 2, 1961

From Today's Costs Come Tomorrow's Savings

Because it is preoccupied with 1960 operations of the utility industry's newest power plants, *Electrical World's* 12th Steam Station Cost Survey this year offers a unique chance to compare present findings with those of earlier surveys across the decade of the Fifties.

Such comparisons not only permit several observations regarding the trend of today's costs, but also suggest directions from which tomorrow's improvements may be expected.

Today the industry may take justifiable pride, for instance, in the fact that the over-all trend of busbar energy cost produced in modern plants is down and has been down since 1950, in spite of upward excursions in 1954 and again in 1956. Whether this trend will continue depends largely on whether the effects of inflation on labor and material costs, that were the hallmark of the Fifties, can be matched successfully by operating economies in the years ahead. In short, whether technological progress can sustain its present pace.

Net station heat rates for the newest plants have held a steady ten-year decline, reaching a new low average of 10,356 Btu per net kwhr in the 12th Survey. This is a clear reflection of the rapid growth that has taken place in station and unit sizes, the progress that has been made up the scale of steam pressure and temperature, and the widespread and growing use of single and double reheat throughout the decade. It's reasonable to expect this trend to continue, although perhaps at a slower rate, as still larger plants and units, now planned, come into operation at sub-critical steam pressures and higher.

The operating cost component of busbar energy, of which upwards of 80% is fuel, has benefited most from advances in steam technology. And it will continue to do so. But it will also continue to shadow the shape of the fuel-cost curve which may be expected to climb at a moderately slow pace in the years immediately ahead. When account is taken of improved thermal efficiencies, we see that from 1950 to 1960 the fuel component of energy cost rose only 6% although the Btu cost of fuel consumed climbed 19%.

Favorable financing has held fixed charges across the decade to 72% of the 1950 level in the face of inflationary forces that drove station unit costs, by 1960, to an average of $152.50 per kw. This is more than $20 per kw above the ten-year low of $131 per kw reached in 1954. And it's alarming to observe in this connection that the spread between the average or median-cost plant and the highest-cost plant is increasing. In short, expensive plants are becoming more expensive!

It's also surprising to find several instances in the 12th Survey where plants of comparable size and efficiency differed by as much as $120 per kw in cost, mainly on the grounds of plant enclosure and type of fuel burned. This amount seems to be excessive, and appears to hold the seeds of savings.

Certainly no one decries the effort and the money invested in the improvement of station thermal economy. But it does seem likely that an equal effort spent in reducing the cost of station enclosure and the investment in fuel systems might bring dividends in lower station cost and lower fixed charges.

Did Congress Put Strings On Upper Colorado Lines?

Conferees say Udall is bound to negotiate with utilities, but he gives go-ahead for federal backbone system

A weary Congress, racing to close its doors last week, agreed to a compromise version of the big Public Works Appropriation Bill for fiscal 1962—and it also agreed to some confusing language in a Senate-House conference report on the bill which appears to give the Interior Department the go-ahead to build an all-federal transmission grid for the Upper Colorado Project.

The question left behind by the harried legislators as they scurried for home last week: Is the Interior Secretary morally bound to seek further negotiations with investor utilities in the Upper Colorado area before proceeding with an all-federal network?

Interior Secretary Stewart Udall issued a statement, vague in spots, indicating that he believed he had been given a Congressional mandate to go ahead with a federal backbone transmission system in the Upper Colorado states.

The conferees knocked out earlier language in the Senate Appropriations Committee report, which had clearly directed the Interior Secretary to arrange further negotiations with the five mountain state utilities on possible wheeling arrangements (EW, Sept. 25, p 38-39).

Substituted for this was a hazy statement that the Bureau of Reclamation could proceed to build the federal lines "unless the Secretary of the Interior finds it practicable and in the national interest to enter into wheeling agreements with private power interests." The Senate-House conferees approved this language by a vote of 10 to 6.

Some members of Congress, however, felt the language was to be interpreted differently—they felt that Interior still is required to negotiate with the five companies. Rep Ben Jensen (R-Ia.), a House conferee, said later, "We did get language in the report which makes it mandatory on the Secretary of the Interior to make an effort to work out wheeling contracts with the five utilities who are interested in this project." But he added, "it is not very demanding."

Sen Allen Ellender (D-La.), a conferee, told the Senate after the report was issued, "I am still hopeful that Mr. Udall will make every effort to get these lines constructed by the private utilities . . . The fact that we have provided the funds to enable the Secretary of the Interior to proceed may spur the private utilities to enter into an agreement as soon as possible."

Chairman Carl Hayden (D-Ariz.) of the Senate Appropriations Committee told the Senate, "I am sure the Bureau of Reclamation will not close the door to timely proposals by the investor-owned utilities which may result in arrangements which are mutually beneficial . . ."

Secretary Udall promptly announced that his department would "implement the decision of the Congress and proceed forthwith to construct the basic backbone transmission lines needed to market Colorado River Storage Project Power. At the same time, we will carry out the recommendation of the Congress, and conduct negotiations with all power suppliers in the area with respect to inter-connections and wheeling agreements —beyond the basic backbone system . . ."

Dominy: "We Have Authority"

Reclamation Commissioner Floyd Dominy interprets this conference wording as a mandate for federal construction, since it is in sharp contrast to the negotiation which earlier had been required in the Senate report. He said he felt the language in the conference report probably refers to future wheeling arrangements for delivery to customers from the load centers, rather than to any of the contested lines. Dominy told *Electrical World*, "We've got the authority, we've got the money," and implied the Bureau would move ahead quickly to start federal construction.

Other New Starts Approved

In addition to funds to start on the federal Upper Colorado transmission lines, the public works bill also includes $5 million to start work on a federal tie between the Trinity hydroelectric project, Calif., and the Central Valley System. Pacific Gas & Electric Co battled this request as hard as the five mountain state companies fought Colorado lines, but PG&E didn't get much publicity on its fight. The company claims it could save the government about $122,000 in project costs over a 54-year period, by wheeling Trinity power to the Central Valley System at a charge of less than 0.5 mills per kwhr.

A $279,500 appropriation to build a duplicate federal line from the Central Valley project to the Shasta area PUD, Calif., was deleted from the big money bill. This line, from Keswick to Toyon, Calif., was knocked out because it paralleled a PG&E line—and the company already was wheeling Bureau power to the PUD.

Significant studies by the Bureau, which received funds in the conference version, are: **(1)** Pumped-storage power, $150,000; **(2)** Federal interties, $300,000. The Corps of Engineers may get a similar sum for pumped-storage studies in a future year, after the Bureau makes its initial study to determine where it has possible sites, and where it has need for more power.

Intertie Studies Get Money

The $300,000 item for intertie studies will be matched in fiscal 1963 with another request for $300,000. Although these studies are aimed initially at the Bonneville-California line—with emphasis on how Canadian storage projects and power would affect its feasibility—and at the Colorado transmission lines, undoubtedly studies will be carried out to determine the feasibility of lines between Bonneville and the Missouri Basin and between other federal power plants and most major load centers.

The Interior Department denies that these studies are aimed at planning a nationwide "giant power" federal grid.

Federal Power Commission Reorganized for Efficiency

A "new" Federal Power Commission is operating now in Washington, with a full complement of commissioners for the first time in more than a year and a reorganized staff organization strengthening the bureau of power, among other things.

Charles Ross, 41, a Vermont Republican and chairman of that state's Public Service Board, was confirmed last week by the Senate, giving the FPC three Democratic and two Republican members (EW, Sept. 25, p 39).

Ross told the Senate Commerce Committee during a short confirmation hearing that he doesn't think a regulatory person can "take up sides and choose sides" between public or private power. He added that he favored "good service at reasonable rates"—almost a direct quote from the Federal Power Act.

While chairman of the Vermont board, Ross supported state legislation to: insure power pooling; authorize the board to order rate decreases; require board approval on contracts between affiliated utilities; place co-op systems partly under board jurisdiction; and raise gross receipts taxes to permit more money to expand the board's staff.

Bureau of Power Strengthened

FPC Chairman Joseph Swidler, who took that office Sept. 1, quickly ordered a reorganization of the commission's staff, mainly to improve operations. The result was to strengthen the bureau of power, to set up a separate bureau of natural gas, to create a new bureau of economics, and to revise the old office of chief accountant:

- The old bureau of rates and natural gas certificates was split in two: power rate report functions going to the bureau of power, and all gas functions being separated in a new bureau of natural gas.
- The old office of the chief accountant was split: its division of economics was elevated to a level equal to the other bureaus, reporting directly to the commission, and the remaining accounting functions were left in a renamed office of accounting and finance.

CHARLES ROSS

The transfer of rate regulation to the bureau of power is intended to allow "further integration of electric power regulatory functions under one bureau, thus facilitating program planning and control." And it also should "eliminate any problems of coordination between two separate organizational units, as in the past."

Con Ed Orders First 1,000-Mw Unit

Consolidated Edison Co announced last week that it has placed an order for the world's largest turbine generator, a unit expected to have a capacity in excess of 1,000-Mw, with the Allis-Chalmers Manufacturing Co. Budgeted cost of the entire generating facility, including the new turbine generator and its associated boiler, is $131 million. It will be located on a site adjacent to Con Edison's East River Station at the foot of 14th Street in Manhattan. Completion is scheduled for early 1966, Harland C. Forbes, chairman, announced.

The turbine generator is to be a cross-compound design operating on steam at 2,400 psi, 1,000F, with reheat to 1,000F. The turbine's five sections will be on two shafts, operating at 3,600 and 1,800 rpm, each driving fully super-charged, hydrogen-cooled generators. The high and intermediate pressure turbine sections will be on the 3,600-rpm shaft, the three low-pressure sections on the 1,800 rpm shaft. Shipment of components by the manufacturer is expected to start in 1964.

In announcing the new unit, Forbes said that recent developments in technology have made machines of this size, with the consequent savings in investment cost-per-kwhr, feasible for utility systems large enough to absorb the great blocks of power such generators can produce.

Con Ed's present capacity is over 5,000 Mw and will rise to over 6,500 Mw when generating units now on order are completed. Through existing interconnection with neighboring utilities the company is part of a 40,000-Mw block of generating capacity that stretches from Montauk Point, Long Island, to Quebec; from Maine to Michigan.

Interties Help Feasibility

Con Edison has long had ties with Niagara Mohawk and with Long Island Lighting Co. A new high-voltage tie was recently completed with Orange & Rockland Utilities. Next year additional ties with Niagara Mohawk will quadruple the exchange capacity between the two systems. Investigation of ties with Public Service Co of New Jersey at several points, and with the Connecticut companies, is well advanced, Forbes said.

In locating the new generating facility adjacent to its East River Station, Con Edison will demolish existing buildings on the site and rearrange its facilities in neighboring streets. Actual construction is scheduled to be under way in 1963.

B. C. Power to Try to Sue Province for More Money

Directors of British Columbia Power Corp, dissatisfied with the price established by Prime Minister W. A. C. Bennett when he seized the subsidiary British Columbia Electric Co (EW, Aug. 14, p 64), have decided to attempt the difficult, and perhaps impossible, task of suing the province for an increase in compensation.

But to sue the government the company must obtain a fiat from the provincial attorney general, an appointee of the premier, who thus far has not indicated if he will grant it. Because Bennett has stated that no arbitration will be granted by the government, observers were not optimistic over B. C. Power Corp's chances of getting its case before the courts.

A. Bruce Robertson, president of B. C. Power Corp, said, "In every free democracy the right of access to the courts is the one fundamental right of the citizen. If the attorney general chooses to pigeonhole our petition, there is no law that can compel him to do otherwise."

The company's audit concluded that net worth was far in excess of the $110 million the government paid for B. C. Electric and the $180 million offered for all B. C. Power Corp assets. If a case were decided in the company's favor, the government might wind up paying as much as $500 million.

Further development of the Columbia River in accordance with the US-Canada treaty remains dubious after Bennett and federal Justice Minister Davie Fulton exchanged bitter charges. Bennett accused Fulton of using the Columbia, which Bennett termed a giveaway to the US, as a pedestal on which to build Fulton's own political image. Fulton warned that the federal government was studying all methods of putting the development of the Columbia ahead of the Peace River, the mammoth project in northern British Columbia that Bennett advocates.

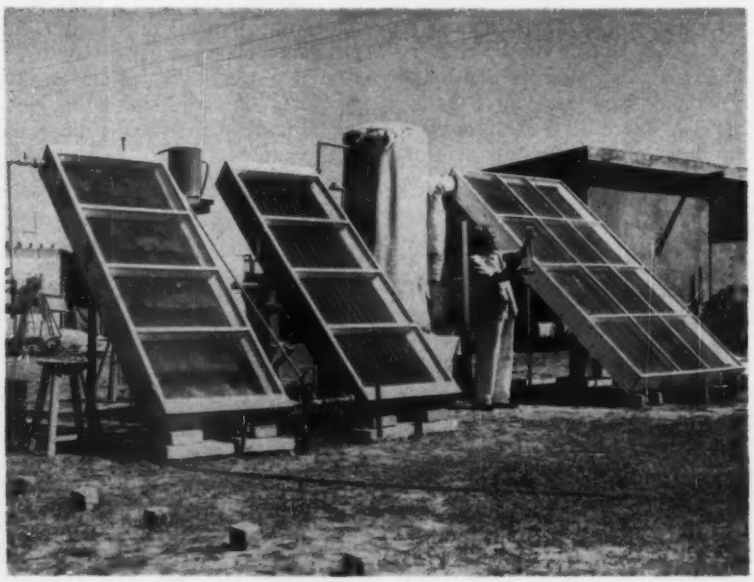
Nevertheless, Fulton warned that the federal government would allow the treaty to lapse before it permitted a long-term sale of Canada's share of the downstream power in the US. He warned that the US was getting restless and Canada has only five months to ratify before the US washes its hands of the project. Spokesmen for Bennett, though, feel certain that the US won't be content to drop the treaty and will put pressure on Ottawa to go along with Bennett's terms.

Shrum Negotiates With Luce

Dr Gordon Shrum, named by Bennett to run the nationalized B. C. Electric Co, has been negotiating with Bonneville Power Administrator Charles Luce on sales of Canadian power from the Columbia, if Ottawa grants an export license. Luce termed 5-mill power, Bennett's Columbia price, "a little high but not right out of the ball park," and predicted further talks.

Bennett's program for the Peace has picked up steam. Shrum appointed R. W. Bibbs as manager for the project, and a contract is to be awarded soon for a bridge and the first four pilot tunnels. There is, however, a possibility that Fulton could hold up the project by refusing the necessary federal license under a navigable waters act.

Province officials have hinted that two big industrial groups are considering setting up large scale operations in the Peace River area because of the promise of power. The concerns have not been identified, except that one is reportedly interested in electrolytic processing of metals, and the other produces chemicals in bulk.



Conference on Energy Sources Held

The application of solar, wind, and geothermal energy to promote economic development in underdeveloped countries was the subject of a recent United Nations-sponsored conference held in Rome.

The more than 500 experts gathered there had a chance to swap ideas and report on their continuing efforts to utilize these age-old sources of energy, using present-day techniques.

Solar energy dominated the conference because of the great variety of applications possible—electricity production, cooking, fresh water production, and heating (such as the solar water heater being tested in India in photo above).

Esther Glances Along Atlantic Coastline

Atlantic Coast utilities were spared severe damage from Hurricane Esther which stayed for the most part out at sea. The utility apparently suffering the heaviest damage from 100-mph winds was Long Island Lighting Co, but even its damage was relatively light.

The company reported that the storm knocked out 280,000 of its 600,000 customers, but after 16 hr, only 65,000 homes were without power.

Heavy rains and gusty winds hampered the restoration efforts of the 3,500-man repair force, mustered from the company's own manpower pool and from assisting companies. Commonwealth Edison Co, Chicago, and Consumers Power Co, Jackson, Mich., each sent five five-man line crews by air.

In Westchester County, a Consolidated Edison Co lineman was killed when he touched a hot wire while attempting to restore service in New Rochelle.

On the Connecticut coast, United Illuminating Co had 10,000 customers out in its New Haven division at the height of the storm, and a maximum of 11,000 out in the Bridgeport area, but at different times. By the following noon, less than 2,000 homes remained to be restored. The company used a storm emergency plan that had been put through a successful dry run a month before. Three crews from Western Massachusetts Electric Co assisted in restoration work.

By the time Esther reached Cape Cod, it "was no different than a heavy northeaster," Cape & Vineyard Electric Co reported. The company lost only about 1,500 of its 54,000 customers.

BRANCHES, BRANCHES EVERYWHERE as Long Island Lighting lineman clears lines. But damage was light

Two REA-Approved Generating Loans Await PUC Approvals

An $18,736,000 Rural Electrification Administration loan to Southern Maryland Electric Co-op, Hughesville, Md., is in about the same position as the big $60-million REA loan to Hoosier Cooperative Energy, Inc, Ind. (EW, June 26, p 42)—both loans have been approved by REA, but loan funds for each may not be advanced until their respective state utility commissions approve the loans. Southern Maryland's loan application was approved by REA in 1960.

Potomac Electric Power Co, however, has challenged Southern Maryland's loan request before the Maryland Public Service Commission. Pepco claims the co-op's plan to build its own three-unit, 99-Mw steam generating plant would be "wasteful duplication" of Pepco's generating facilities. Pepco presently supplies all the co-op's wholesale power for its 125,000 customers —an annual sale of nearly $2 million.

Southern Maryland claims it can save about $3.1 million between 1964 and 1972 by building its own plant. It adds that annual power requirements in the Southern Maryland territory should increase 60% by 1972, and "the time has come to sever this umbilical cord which binds us to Pepco or any other utility . . ." The co-op also says, "It has become economically feasible for us to produce our own power. Our growth prospects are very good. We can do what we say we can do, and we ought to be allowed to do it."

Pepco claims it can produce the power cheaper from its larger generating units than Southern Maryland can, and that the co-op's smaller units would require up to 25% more coal per kw of power produced. Regardless of the outcome of the co-op plant, Pepco is building two 335-Mw units not far from the site proposed by the co-op.

Southern Maryland turned down a Pepco offer whereby the company would sign a 15-year contract to sell the co-op wholesale at 8.5 mills per kwhr, plus fuel cost adjustments. If the co-op loan is approved by the PSC, Pepco would continue to sell power to Southern Maryland until 1963 at its present rate of 9.1 mills.

Another angle in the commission hearings, which will be resumed Oct. 4, developed when the commission counsel said, "If utilities can spend money fighting a cooperative, and then charge off the costs to customers, I think we need a (commission) policy review of the issue."

CO-CHAIRMAN J. E. Nicholson (right) of Jefferson Electric Co-op chats with Carl Bremicker, Northern States Power

NUCLEAR PROJECT studied by Ralph Sorenson, Westinghouse; Edwin O. George, Detroit Edison, and A. N. Prentice

Clapp Urges Sales Cooperation

All segments of the electric industry can grow and prosper—"if we do the right sort of job"—Norman M. Clapp, REA administrator, told the eighth annual National Electric Farm Power conference in Minneapolis.

"There must be a common ground on which the cooperatives, commercial companies, public power agencies, and the manufacturers can get together and work for mutual benefit," he stated.

The Inter-Industry Farm Electric Utilization Council, Inc, could perform the role of providing this common ground, he said.

Attendance at the farm-power conference, a project of the Inter-Industry Council, was the largest in the series to date. More than 700 registrations were made from 35 states.

Co-chairmen of the conference were J. E. Nicholson, manager of the Jefferson Electric Cooperative, Inc, Brookville, Pa., and A. N. Prentice, vice president and general manager of Ohio Power Co, Canton.

"The growth potential of this electric industry we represent here is so tremendous that some people can't believe it," Clapp told the conferees, including power suppliers, equipment manufacturers, distributors, dealers, farm publications, agricultural agencies and educational institutions. "Or at least they act as if they don't believe it," he said.

"Several letters have been sent to me recently asking if it is true that the rural electric systems are invading cities and taking over the customers and industries served by urban electric systems.

"It takes a bit of patience and a sense of humor to turn this canard around and head it in the right direction.

"Then there are those who hold the view that the urban electric systems can grow only by cannibalizing the rural electric systems. This is pessimistic, for sure, if not positively morbid.

"As you may have heard or guessed, that is not my view. I believe that all segments of the electric industry can grow and prosper, if we do the right sort of job."

Chairmanship Is Shared

Prentice, conference co-chairman, told those in attendance that the change to a shared chairmanship of the organization resulted from Clapp's suggestion. (The investor-owned utility companies and REA's previously had equal representation on the national council and the deputy REA administrator acted as chairman.)

Prentice referred to Clapp's conference speech and the fact that the administrator had said the REA would continue to give help with the many details and routine matters necessary for the operation of the council and conducting the annual meetings.

Louis H. Roddis Jr, president of Pennsylvania Electric Co, told the conference that the search for better materials in the industry is closely woven with research and development of nuclear power.

"It is highly possible," he said, "that a breakthrough in the so-called 'hardware field' will mean that nuclear generation has become competitive with conventional thermal generation."

Referring to the broad field of competition for the consumer's dollar, Roddis said, "We cannot permit a difference in philosophy to interfere with finding new and better ways to meet this type of competition.

"The customer is far more interested in the advantages of electric space heating than he is in whether the kilowatt-hours were delivered over REA-financed lines or those of an investor-owned utility.

"His interest in a flameless water heater is in direct proportion to his need for a water heating device. I am sure that taking a shower with water heated by Penelec kilowatts instead of Nick Nicholson's (co-chairman of the conference) kilowatts won't make me smell any better."

Water Heater—Key Appliance

Ralph Z. Sorenson, manager of the utility sales department, Westinghouse Electric Corp, Mansfield, Ohio, told the conference that next to home heating, "the water heater represents your greatest potential for rapidly increasing the average residential consumption of your customers.

"An electric home heating installation may mean an additional 20 to 25,000 kwhr in annual consumption," he said, "but an electric water heater by itself means in the neighborhood of 4,000 kwhr and there is no other domestic appliance that comes anywhere near to that annual consumption of electricity," he added.

AEC'S STELLARATOR PROJECT at Princeton, N. J., aims at the control of fusion for electric energy production

Flicker Controlled at Stellarator

Three-winding main transformer isolates large dc pulsed load from the building service supply of AEC facility

JAMES M. WATERS, Senior Professional Electrical Engineer, Electrical Dept, Commonwealth Associates Inc, Jackson, Mich.*

Reliability with no flicker problem under pulsed load conditions and at least cost was the keynote for designing the electric power system for the Atomic Energy Commission's Project Matterhorn facility at Princeton University. This facility includes Princeton University's Model C Stellarator, a research project on controlled fusion reaction of hydrogen atoms. The facility requires large amounts of dc power along with high frequency supply and special equipment services.

Power requirements included supply to three large m-g sets with 7,000-hp drive motors, and one m-g set with a 1,500-hp drive motor, two 1,750-hp electrically driven water chillers for cooling, a large cooling tower and pump house for water supply and miscellaneous equipment, auxiliaries and building services. The large m-g sets each consist of four 4,000-kw dc generators and a 96-ton flywheel for short circuit output at short time intervals. Special equipment, such as vacuum pumps, require constant power supply with an estimated maximum outage time of 15 sec.

Another AEC facility, the Princeton-Penn Accelerator, was being constructed simultaneously under another contractor about one mile from the Model C site. Studies indicated that substantial savings could be effected by providing power to both facilities through a common utility connection at 132 kv, a 26-kv overhead tie between the two facilities, and a 26-kv power company connection for emergency power service to both projects.

Demand 50,000 Kva

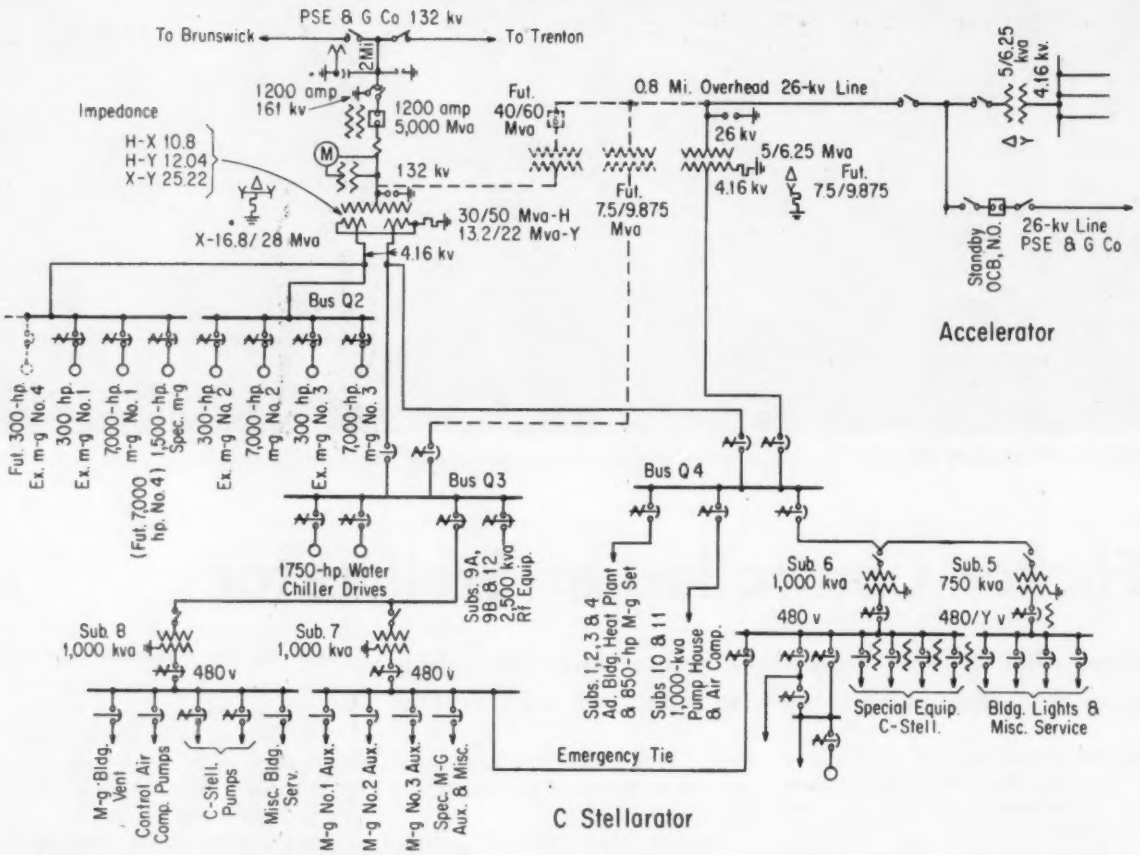
Preliminary estimates indicated that the ultimate power demand at the Stellarator would be about 50,000 kva and at the accelerator about 45,000 kva. The demand at the Stellarator would rise to the maximum in about six years, while incremental increases at the accelerator were predicted to be 5,000 kva each year. A 50,000-kva step-down transformer was procured for the Stellarator site with 18,000 kva allocated for the accelerator for the first three years of operation. The main components of the system are shown on the next page, top.

Distribution voltage was established at 4.16 kv as the most economical for the 7,000-hp m-g set drive motors, which constituted over 50% of the demand at this facility. A 5/6.25-Mva, 4.16-26-kv transformer steps up the distribution voltage to transmit power to the accelerator over the 26-kv tie line.

When demand at the accelerator exceeds 6.25 Mva, the 5/6.25-Mva transformer will be relocated to the accelerator for step-down service and be replaced by two 7.5/9.375-Mva transformers to supply the accelerator. When this capacity is exceeded, these will be relocated to the accelerator also and be replaced with a 40/60-Mva, 132-26-kv transformer for the accelerator supply, thus releasing 18.75 Mva for use at the Stellerator. A 26-kv utility connection at the accelerator makes 1,000 kva of emergency power available for service to the vacuum pumps, heating plant and other essential services at the Stellerator site.

To eliminate fluctuations in voltage on the building service supply due to the pulsations in the output of the large m-g sets, a three-winding 50-Mva transformer was selected for the main supply service. All of the pulsed loads are on one winding; the building service and steady-state equipment loads are on the other. The high-voltage winding impedance in the equivalent-Y impedance diagram is of a negative value sufficient to approximately balance out the positive-sequence impedance

* Since the writing of this article, the author has associated with Mead & Hunt, Inc, Madison, Wisc., as chief electrical engineer.

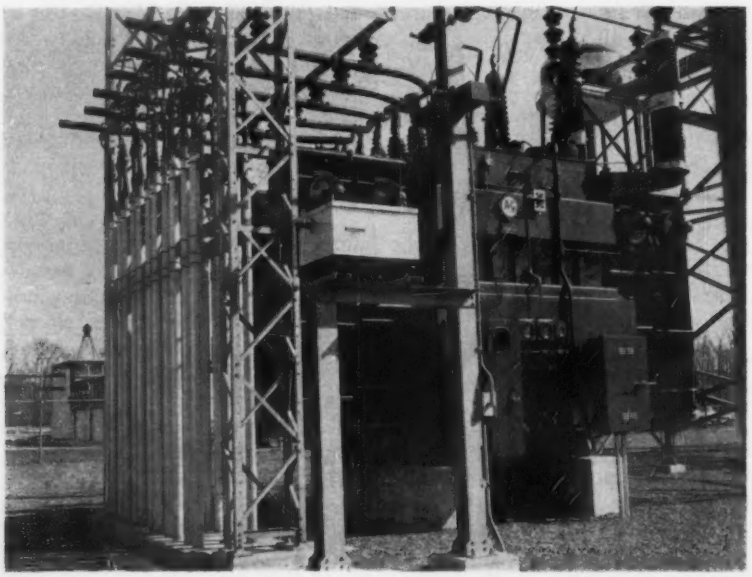


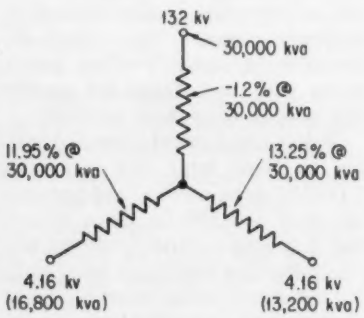
MAIN COMPONENTS AT STELLARATOR SITE are served from separate windings of 50-Mva main supply transformer to isolate pulsed load (buses Q1, Q2) from rest of load. Power supply also serves AEC's nearby accelerator

and minimize the effect of load fluctuations on the tertiary-winding voltage. Impedances are shown below.

Pulsating motor loads were connected to two buses of 4.16-kv switchgear dividing the load on the 28-Mva winding equally. This allowed the use of 2,000-amp buses and 350-Mva breakers, a combination readily available and the most economical. Buses are each fed by

(*Continued on page* 126)





Equivalent Impedance Diagram

KEY TO FLICKER CONTROL is 3-winding, 30/50-Mva, 132-4.16-kv transformer. Its impedances were carefully selected so negative HV winding impedance approximately balances the positive-sequence impedance on the tertiary winding

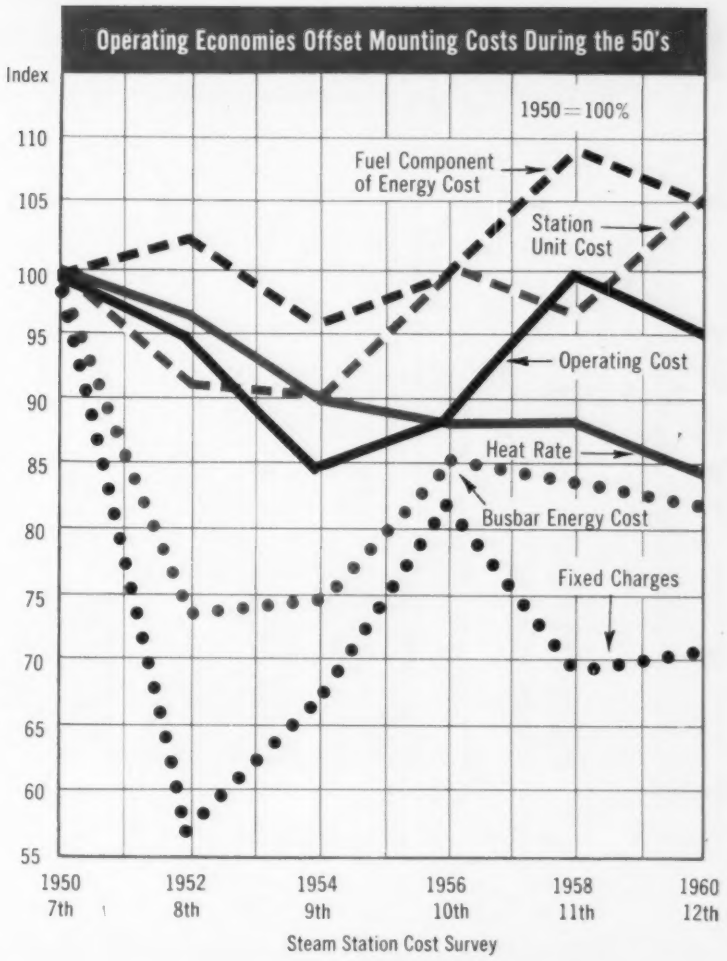
12th Steam Station Cost Survey

Dan Braymer, Senior Editor

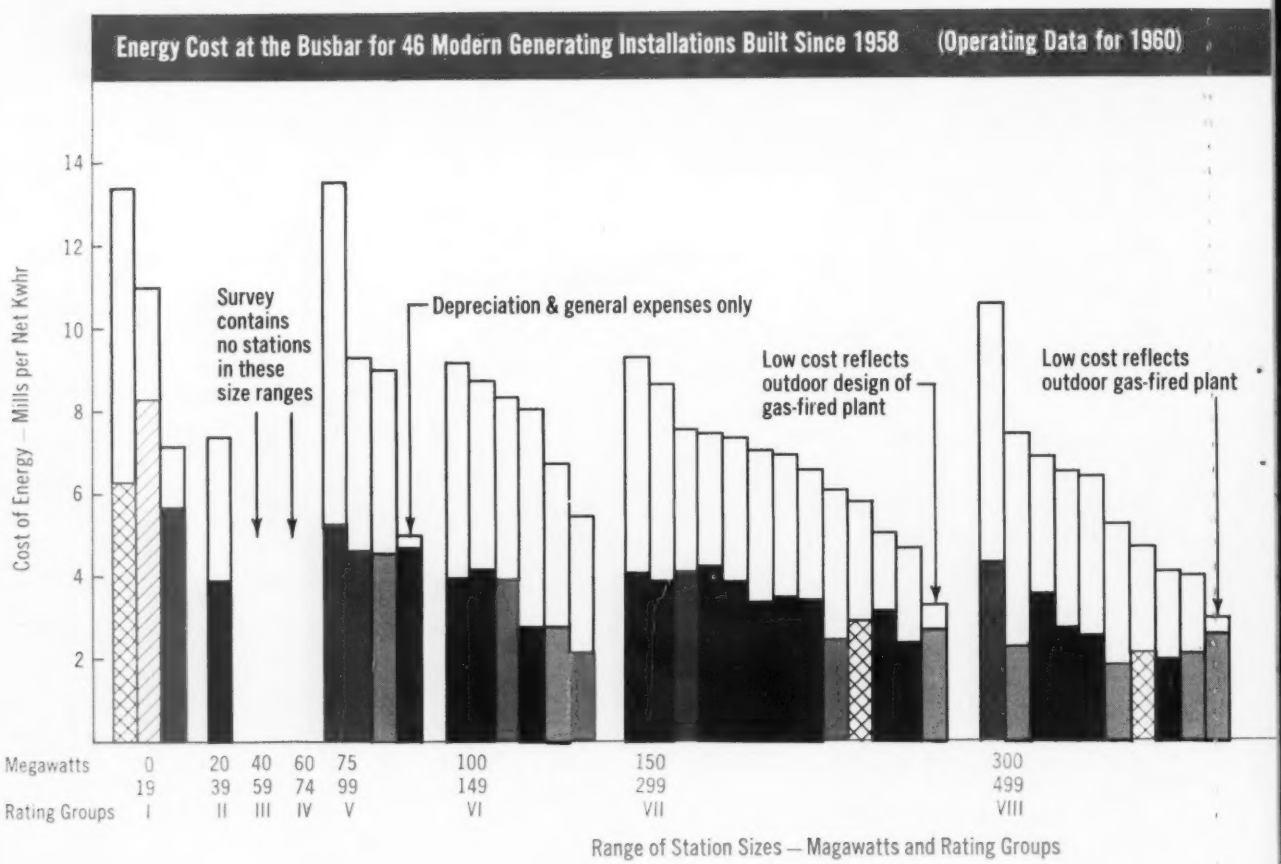
On this and the following pages, *Electrical World* presents its most recent summary and evaluation of cost trends associated with the construction and operation of today's newest steam plants.

New data are offered on the 1960 performance of 57 new and expanded older generating stations whose facilities were placed in operation in 1958, 1959 and early 1960.

New data embrace approximately 20,000,000 kw of new generating capacity in more than 150 units some of which are among the largest in operation.



Stations started since last survey and operated throughout	12th Survey 1960	11th Survey 1958	10th Survey 1956	9th Survey 1954	8th Survey 1952	7th Survey 1950
Busbar Energy Cost (mills per net kwhr)	6.90	7.04	7.15	6.3	6.25	8.40
Construction Cost—excluding switchyard (dollars per kw)	152.50	140.60	146.00	131.00	133.00	145.00
Fixed Charges (mills per kwhr)	3.40	3.32	3.90	3.20	2.75	4.75
Operating Costs (mills per kwhr)	3.50	3.72	3.25	3.10	3.50	3.65
Fuel Cost (mills per kwhr)	2.89	3.00	2.70	2.57	2.80	2.73
Fuel Cost (¢ per million Btu)	26.45	27.4	23.7	23.6	24.4	22.2
Fuel Cost, portion of operating costs (percent)	82.5	80.8	83.0	83	80	75
Manpower Requirements (operating & maintenance employees per Mw)	0.306	0.37	0.37	0.50	0.62	0.71
Station Net Heat Rate (Btu per net kwhr)	10,356	10,934	10,860	11,040	11,850	12,290
Annual Plant Factor (percent)	64.87	61.8	69.0	71.6	70.0	79.4
Utilization Factor (percent)	98.94	100.4	103.0	106.4	105	118


Energy Cost at the Busbar for 46 Modern Generating Installations Built Since 1958 (Operating Data for 1960)
Cost of Energy — Mills per Net Kwhr
14
12
10
8
6
4
2
Survey contains no stations in these size ranges
Depreciation & general expenses only
Low cost reflects outdoor design of gas-fired plant
Low cost reflects outdoor gas-fired plant
Megawatts 0 20 40 60 75 100 150 300
19 39 59 74 99 149 299 499
Rating Groups I II III IV V VI VII VIII
Range of Station Sizes — Magawatts and Rating Groups

Busbar Energy Cost Dips to 6.9 Mills Despite

Energy produced in 1960 by new and expanded power plants put in service in 1958 and later cost an average of 6.9 mills per net kwhr at the busbar. This decline from the energy cost levels of 7.15 and 7.04 mills for 1956 and 1958, recorded in EW's 10th and 11th Steam Station Cost Surveys. Moreover, the 1960 figure marks the first time that energy cost has broken through the 7-mill level since 1954.

Individual plants produced energy at costs that ranged from as little as 2.14 to as much as 13.56 mils. At both extremes, fixed charges were the dominant factor, reflecting the percentage applied to investment.

Analysis shows that 87% of stations produced energy at 8 mills per net kwhr or less. Better than half (54.5%) turned in costs of 7 mills or less, while 33% reported 6 mills or less. Four years ago, in 1956, these percentages were 63, 40 and 28%, reflecting a general lowering of energy costs all along the line.

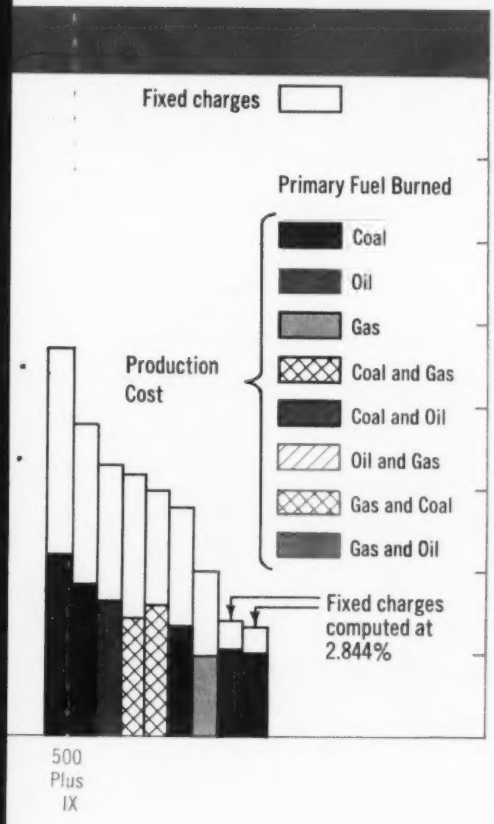
The link between station size and busbar energy cost becomes apparent when average energy cost of stations in each rating group is compared. Costs climb steadily from 5.63 mills for stations 500 Mw and up to 5 88 mills for 300 to 500 Mw; 6.61 mills for 150 to 300 Mw, 7.71 mills for 100 to 150 Mw; 9.26 mills for 75 to 100 Mw stations, and finally averages 9.77 for stations 40 Mw and less.

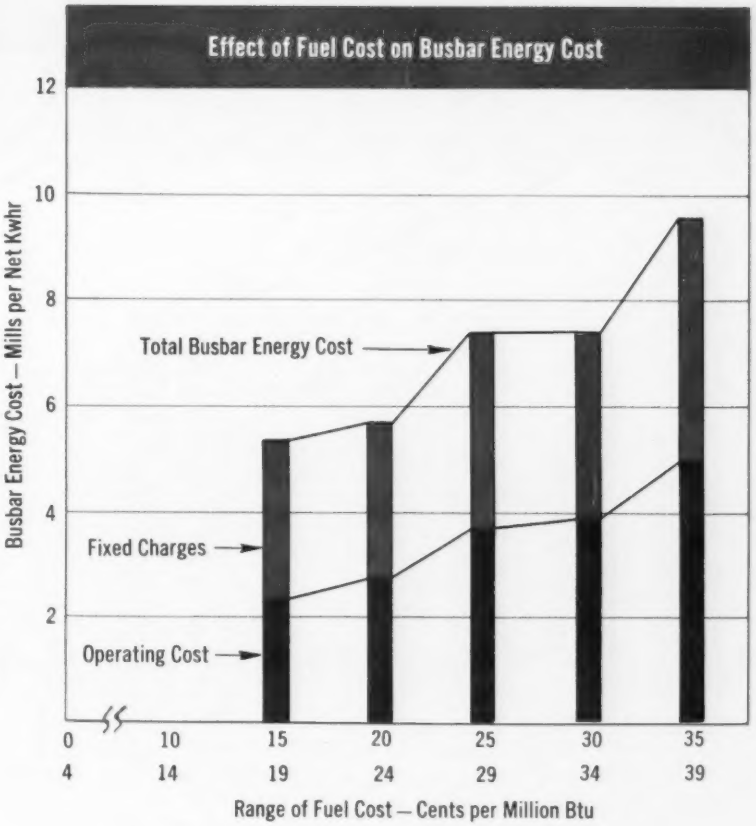
Depending on plant ownership, first cost, and the percentage applied to investment, fixed charges varied over a 20:1 range, from 0.4 mill for an investor-owned outdoor gas-fired plant to 8.25 mills for a city-owned, oil-fired plant.

A 3.5:1 swing in station unit cost and a 7:1 variation in the percentage applied to investment combined to produce erratic fluctuations in fixed charges among stations. Station unit costs averaged $152.50, but ranged from $77.95 for a gas-fired outdoor plant to $273.35 for an indoor oil-fired plant in New England. On the other hand, the percentage applied to investment in computing fixed charges ranged from 2.84 to 20%. Both extremes were for non-investor owned plants. The average for the 41 plants giving these figures was 13.51%.

By comparison, production costs were stable. Fuel which for the present survey made up 82.5% of production costs, was the dominant influence. And it extended over a comparatively narrow range. The lowest reported cost of fuel consumed was 14.91¢ per million Btu for a gas-fired plant in the west South Central region. The highest, 39.6¢, was reported for an oil-fired plant in the South Atlantic region. Mean and median fuel costs were 26.45 and 27.45¢ per million Btu, respectively.

Plant location, in its relationship





Inflation

to fuel cost and the type of plant enclosure, exerts a dual leverage on energy cost. The west South Central region with nine gas-fired and six outdoor plants, has consistently scored the lowest energy, fuel, and station costs, recording averages of 4.82 mills for energy, 18.27¢ per million Btu for fuel, and $101.77 per kw for station unit costs.

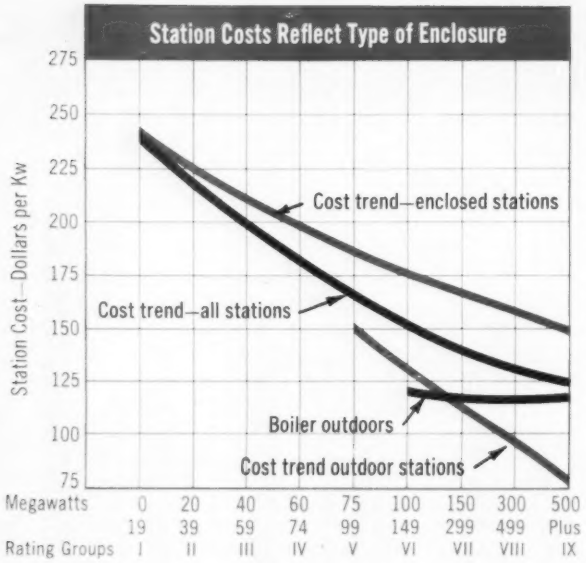
New England, remote from fuel sources and in a climate unfriendly to outdoor plants, booked top costs in all three categories: 8.15 mills for energy; 35.18¢ per million Btu for fuel, and $207.97 per kw for station unit cost. Average energy cost of other regions, in decending order, are: South Atlantic 8.03 mills; Middle Atlantic 7.15; west North Central 7.02; east South Central 7.00; east North Central 6.66; and, Mountain 6.31. The single reporting station for the Pacific region is not considered adequate to reflect regional costs.

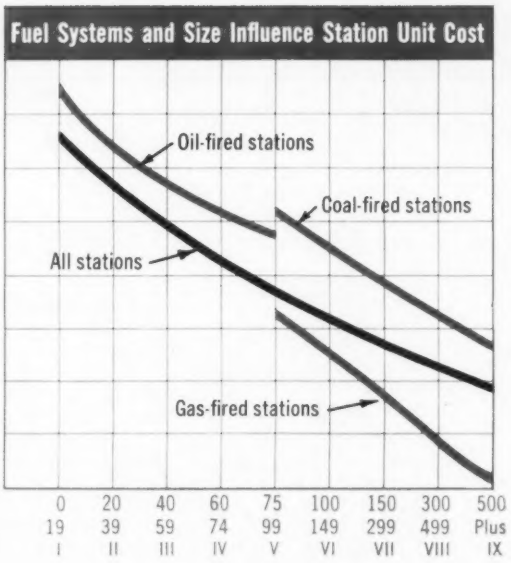
Scope of EW's 12th Steam Station Cost Survey

Reporting stations	57
Total capability	19,682.35 Mw
New stations	24
Expanded stations	33
Largest station	> 1,200 Mw
Smallest station	< 15 Mw
Median station (415)	274 Mw
Average station	345 Mw
Units in 57 reporting stations	151
Largest unit	355 Mw
Smallest unit	7 Mw
Median unit	131 Mw
Average unit (in 148 stations)	128 Mw

Survey covers new generating stations put in operation during 1958, 1959 and the first quarter of 1960. Also expanded older stations with new facilities put in operation during this period, but which were first operated in 1950 or later.

Operating data is for the year 1960 and is for complete stations. Rating of stations and units is on operating capability basis net to the system




Fuel Systems and Size Influence Station Unit Cost
Oil-fired stations
Coal-fired stations
All stations
Gas-fired stations
0 20 40 60 75 100 150 300 500
19 39 59 74 99 149 299 499 Plus
I II III IV V VI VII VIII IX

Inflation Pushes Plant Cost to Ten-Year High

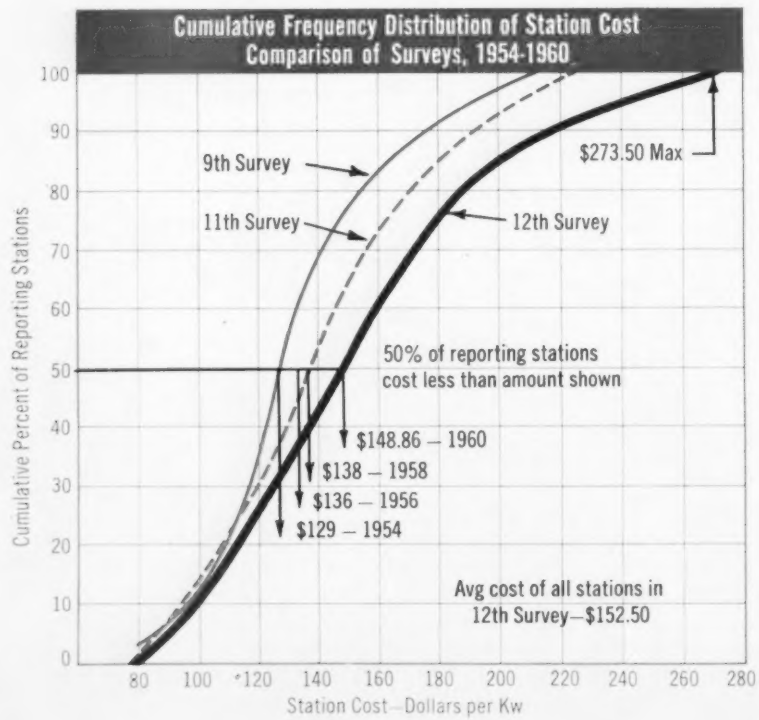
In spite of growing economies in plant enclosure, new and expanded stations facilities put in service in 1958 and later cost more than at any time in the last decade. The average cost of all new stations for this survey is $152.50 per kw, exclusive of switchyard, up $12 since the 11th survey and $21.50 over the 1954 low of $131 per kw.

Historically, outdoor plants burning gas have cost the least. But here the law of diminishing returns apparently has set in. The lowest-cost plants in the last four surveys has hung between $75 to 80 per kw. But the steady increase in the cost of median plants from $129 in 1954 to $148.86 in 1960 marks the increasing inflation.

Other things being equal, the bigger the plant, the lower the unit cost.

Completely outdoor plants of the 12th Survey were built for two-thirds the cost of enclosed plants, or about $55 to $60 per kw less on the average. The 11 completely outdoor plants reporting ranged from $77.93 to $166.43 per kw and averaged $117.53. Again, the bigger the plant, the lower the cost. Enclosed-plant cost swung from $99 to $273, but averaged $174 for 34 plants. For plants with only the boiler outdoors, station cost averaged only a little higher than for completely outdoor plants at $120, but swung from $89 to $159 per kw.

As might be expected, investment in coal systems represents a premium of about $45 per kw on gas-fired plant. The average per kw cost of 14 gas-fired plants in the 12th Survey was $116.80 against $161 for coal burners. But it is important to recognize that 83% of coal-burning plants are enclosed. Therefore, comparisons among plants burning unlike fuels are misleading.



Operating Cost of New Plants Lowest Since 1952

The operating or production cost component of energy generated in 1960 by new and expanded stations of the present survey averaged 3.5 mills per net kwhr. This is 6% below the ten-year high of 3.72 mills in 1958 in new plants of the 11th Survey. It equals the 1952 level.

There was a 2.5 to 1 variation in average operating expense across the range of station ratings, reflecting a similar spread in fuel costs. The latter, for this survey, account for 82.5% of operating cost. Among individual plants, operating costs ranged from 1.86 to 8.28 mills. And again, the biggest plant had the lowest costs. Only about 28% of the stations showed operating expenses greater than 4 mills. And 43% had expenses under 3 mills.

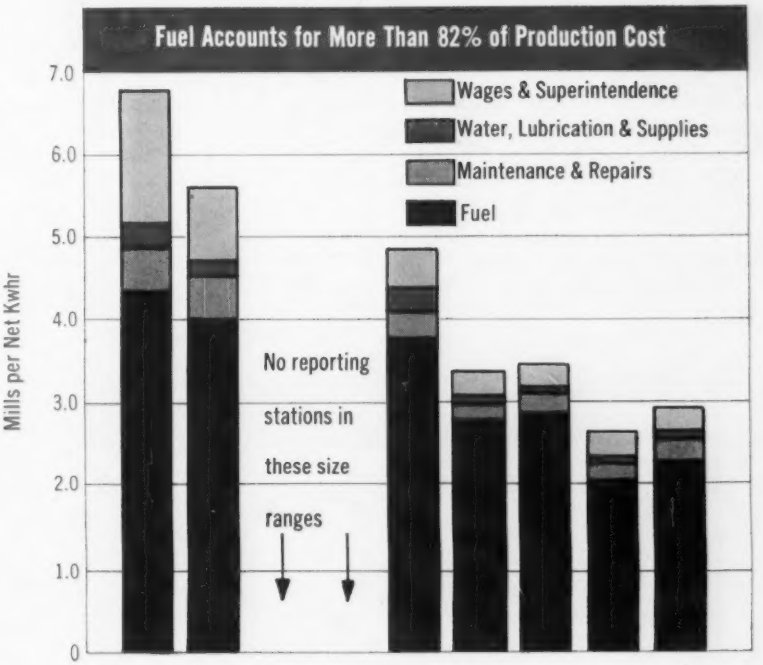
The improvement in operating expenses partly reflects an increase in average plant factor, 62 to 65% since the last survey. Production cost is obviously a function of plant factor, as the heavier a station is loaded, the lower its unit costs.

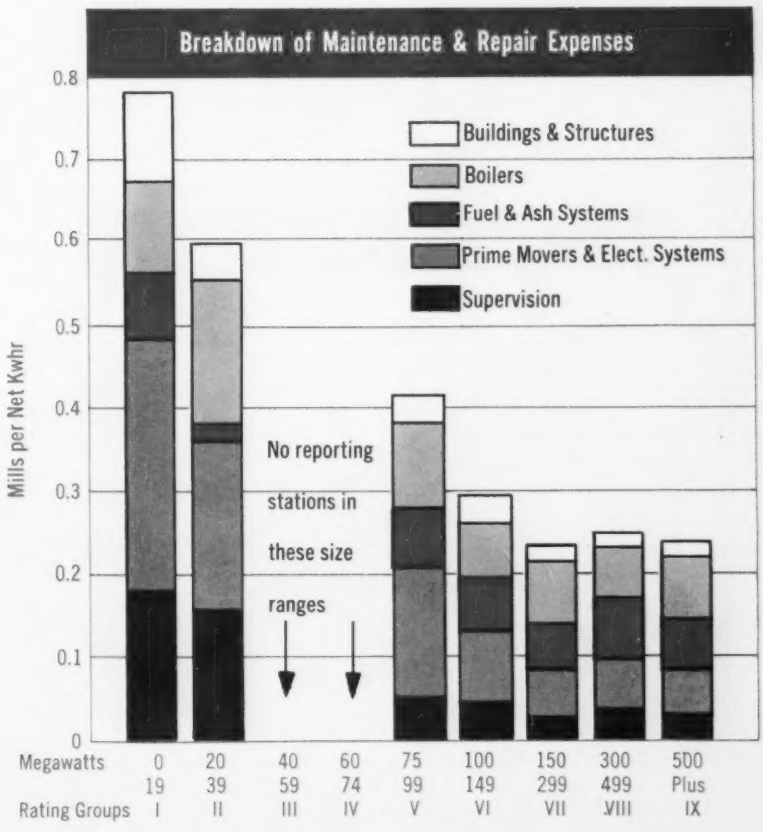
Working with plant factor to produce the 6% cut in operating expenses was a 3.5% reduction in fuel cost, which averaged 2.89 mills for all stations in 1960 compared with 3 mills for new stations in 1958. For plants of 500 Mw and up, it averaged 2.31 to 4.32 mills for those smaller than 20 Mw.

The price of fuel consumed was a factor, too. It averaged 26.45¢ per million Btu for these plants and was 3.5% less than the ten-year high of 27.4¢ for 1958.

Unit labor costs were lower throughout the range of plant sizes for 1960 compared to 1958's new plants. Plants 300 to 500 Mw averaged 0.19 mills per net kwhr in 1960 compared 0.22 in 1958.

Maintenance and repair costs, for this survey, make up from 7 to 10% of operating expenses. The cost of boiler maintenance ranged from 0.06 mills per kwhr for large stations to 0.173 mills for small plants and was the largest single maintenance item. Fuel and ash systems maintenance cost from 0.056 to 0.08 mills depending on station size while the cost of prime mover and electrical system maintenance combined, cost from 0.053 to 0.3 mills.





Plant Heat Rates 15% Below 1950 Level

Net station heat rates for new plants of the 12th Survey reached a ten-year low in 1960 of 10,356 Btu per net kwhr. The range is from 8,975 to 15,567 Btu. Significantly the 10 best heat rates reported all fell in the range between 8,975 and 10,350 Btu. This and the fact that the average heat rate is 15% below the 1950 level reflects the steady increase that has taken place in station and unit size, the improvement in steam conditions, and the widespread use of reheat.

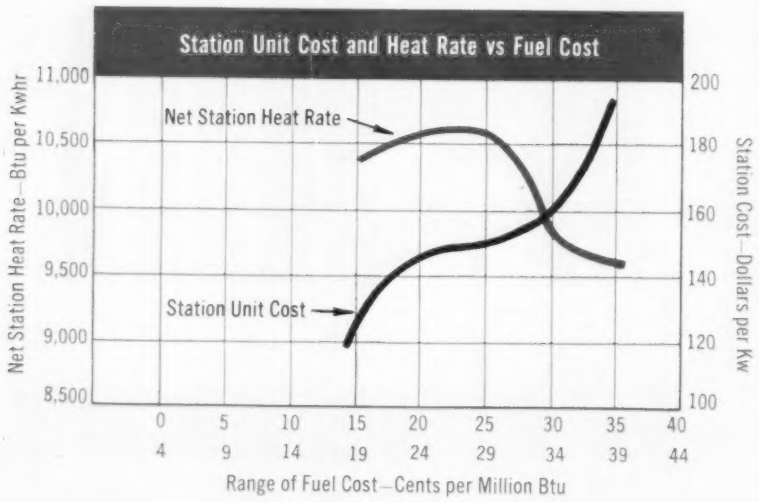
In the current survey, for instance, the average station rating is 345 Mw and the average unit rating 128 Mw. And for the first time, there are five units reported with ratings of 300 Mw or more. Moreover, 44% of participating stations, representing 71% of capability, use steam at 2,000 psi 1,000F or higher. And all but 3% of the reporting capacity use reheat to 1,000F or higher.

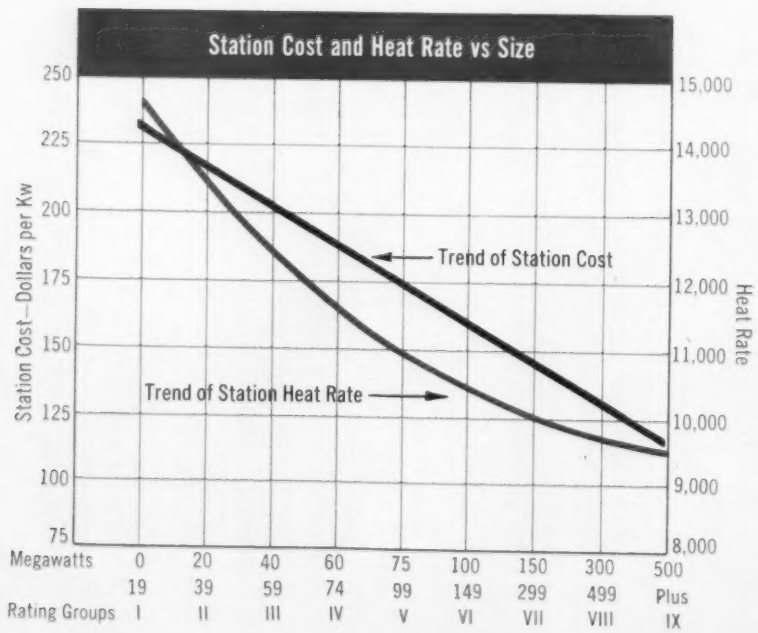
It is notable that the investment in plant and equipment to achieve such high performance has a direct bearing on the price of fuel consumed. For instance, the fortunate few stations at the low end of the fuel price range—from 15 to 20¢ per million Btu—have the lowest station unit costs and accept the moderate heat rates that result. However, in regions where fuel cost climbs above the average and into the range from 30 to 40¢ per million, station unit cost increases sharply toward $200 per kw, as designers reach for station heat rates around 9,600 Btu per net kwhr to compensate for high fuel cost.

At the extremely low fuel costs, down around 15¢ per million, Btu gas-fired outdoor plants depress station unit cost without affecting heat rate proportionately. As fuel price beyond 20¢ per million and coal come into the picture, unit costs climb but heat rates change only slightly. The significant change in the station cost-heat rate relationship comes as fuel costs increase beyond 25¢ per million Btu.

As a consequence, it is not surprising to find station unit costs high and net heat rates low in New England as well as in the South and Middle Atlantic regions where the price of fuel consumed ranges upward from 28 to 35¢ per million Btu. In these areas station unit costs run from $166 to more than $200 per kw and heat rates are commonly less than 10,000 Btu per net kwhr. This contrasts with the west South Central region where fuel costs average 18¢ per million Btu and station unit costs averaging $101.77 yield heat rates ranging from 10,000 to 11,500 Btu per net kwhr.

Further analysis shows that both investment economy and thermal economy are functions of station size. This is demonstrated by the fact that the lowest station unit cost and the best heat rates are achieved in new stations having capability ratings of 500 Mw and more. This nevertheless doesn't disprove that the biggest incremental improvement in heat rate per dollar of investment comes in the small and intermediate station ratings.





Operating Manpower Dips as Control Trend Grows

The proportion of station manpower assigned to different duties today remains little changed that in over recent surveys. But the aggregate manpower employed in stations and the number of men assigned to each class of work has begun to show a small but significant decrease. The principal reductions are in operating forces of the larger stations. They are unquestionably related to the widespread and growing use of centralized control.

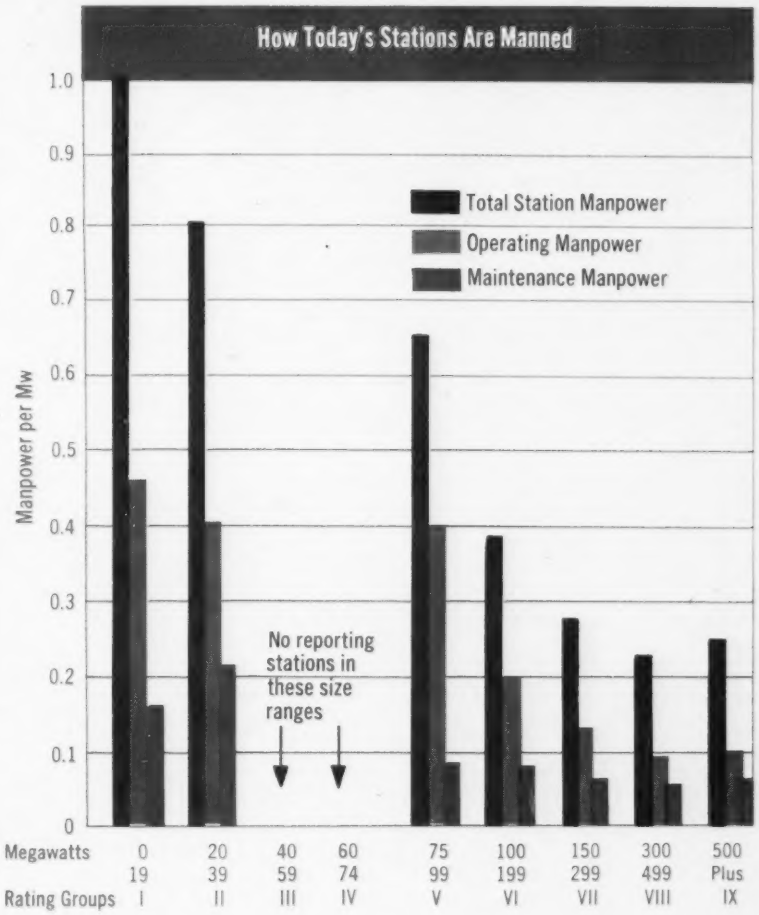
Total plant manpower per Mw ranges from 0.38 to 0.24 among stations larger than 100 Mw. This compares with a range of 0.42 to 0.25 in 1958. In each instance the fewer numbers are associated with the largest (500 Mw plus) plants. Operating manpower over the same span of station sizes varies from 0.19 to 0.09 per Mw in 1960 data compared with 0.22 to 0.11 in 1958.

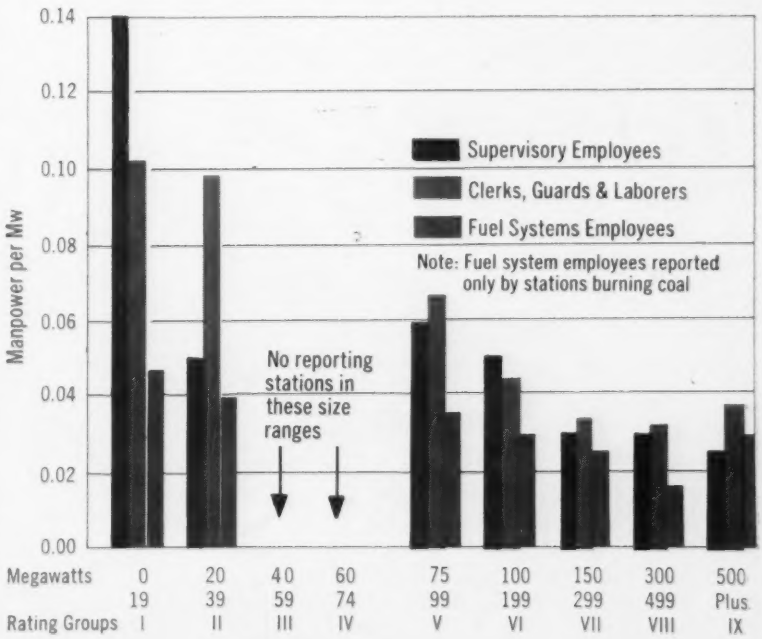
Maintenance manpower per Mw hasn't changed significantly between surveys, nor does it vary much with station size. It stays between 0.08 and 0.058 for most station sizes, Station maintenance crews make up 12 to 26% of all station employees, depending on station size.

Taken together, operating and maintenance manpower for new plants as a whole was 65.3% of the station force. This is about five percentage points below the average of all new stations in 1958. Looking a bit closer, we see that in large stations (150 to 500 Mw plus) O&M manpower makes up 63 to 68% of station forces. At intermediate stations (75 to 150 Mw) the proportion is 71 to 74% and for small plants (20 to 40 Mw) 77%.

As might be expected, operating and maintenance manpower requirements vary with the fuel burned and station size. The difference is most pronounced in the bigger stations of 150, 200 and 500 Mw plus. For these sizes coal stations require from 1.36 to 2.8 times as much manpower as gas or oil fired plants.

Fuel systems manpower requirements are fairly constant. For most station sizes they average about 0.025 men per Mw and comprising of 9.4% of plant forces. Of course it should be recognized that fuel forces are mainly in coal plants.





Cost and Performance Data of

STATION NUMBERS †	387 (191, 236)	388 (337)	389 (238, 293)	390	391 (341)	392
GENERAL DATA						
Location	ESC	MA	ENC	ENC	SA	WSC
Year, first operation	1951	1956	1953	1953	1957	1956
newest unit	1959	1959	1959	1958	1960	1960
Total net plant capability*	IX	IX	IX	IX	IX	IX
No. of turbogenerators	10	4	5	4	4	4
Range of unit ratings*	VI, VII	VII	VII, VIII	VII	VII	VII
No. of boilers	10	4	5	4	4	4
Range of ratings (M lb/hr)	1,000 & 1,100	1,650 & 1,960	1,070 & 2,100	1,335 & 1,523	1,160 & 1,800	1,200 & 1,550
Steam pressure (psi)	1,475 & 2,035	2,030 & 2,275	1,850 & 2,400	2,075	2,450	1,935 & 2,225
Steam temp, initial supht (F)	1,003 & 1,053	1,053	1,000 & 1,050	1,050	1,050	1,005
reheat (F)	1,003	1,053	1,000	1,050	1,000	1,005
Cooling water range (F)	38–84	39–74	34–71	33–90	39–86	48–90
Corresponding vacuum (in. Hg)	0.7–2.55	0.82–2.1	0.75–1.67	0.70–2.8	0.9–2.5	1.11–2.98
Plant site area (acres)	598	1,740	458	414	650	664
In use (acres)	82	56	458	155	201	664
Fuel storage, coal (tons)	1,200,000	920,000	1,800,000	730,000	650,000	.....
Oil (bbl)	1,711	1,194	125,000	2,380	1,190	125,000
Employees, total	469	286	188	207	109	62
Supervision	6	6	59	.....	20	3
Operation	181	87	44	.....	39	39
Maintenance	121	78	32	.....	28	11
Clerical, stores	38	26	10	.....	4	1
Fuel handling	63	55	26	.....	12	0
Guards, laborers	60	34	17	.....	6	8
OUTPUT DATA						
Total gross gen (kwhr x 10^6)	7,513	7,070	5,735	6,632	4,172	5,048.78
Total net gen (kwhr x 10^6)	7,094	6,689	5,426	6,333	3,932	4,839.89
Maximum 1-hr peak (Mw)	1,340	1,069	1,004	910	895	799.6
Unit hours unavailable—% of total	12.6	17.4	11.66	13.6	16.9	9.6
FUEL CONSUMPTION						
Primary fuel	Coal	Coal	Coal	Coal	Coal	Gas
Coal (tons)	2,977,204	2,708,412	2,062,881	2,658,960	1,375,212	.....
Btu/lb	11,600	11,490	12,120	10,919	12,990	.....
Ash (%), Moisture (%)	10.5, 9.3	10.8, 9.6	10.07, 7.11	15.5, 6.4	9.36, 5.45	.....
Cost (¢/million Btu)	17.86	18.71	30.23	16.89	27.6	.....
Oil (bbl)	6,347	12,977	.....	.....	.....	97
Btu/gal	136,780	137,110	.....	.....	.....	151,310
Cost (¢/million Btu)	86.17	89.08	.....	.....	.....	34
Gas (M cu ft)	.....	.....	.....	.....	.....	47,016,000
Btu/cu ft	.....	.....	.....	.....	.....	1,046
Cost (¢/million Btu)	.....	.....	.....	.....	.....	18.6
OPERATING COSTS (Mills/net kwhr)						
Wages (incl supervision)	0.20	0.14	0.22	.....	0.14	0.07
Water, lubrication, supplies	0.05	0.04	0.031	.....	0.03	0.01
Maintenance and Repair	0.22	0.20	0.261	.....	0.06	0.10
Total, Oper & mtce (excl fuel)	0.47	0.38	0.516	0.347	0.23	0.18
Fuel	1.75	1.75	2.810	1.561	2.52	1.88
Total operation (incl fuel)	2.22	2.13	3.326	1.908	2.75	2.06
INVESTMENT DATA (Dollars/kw)						
**(310) Land	.....	.....	0.95	0.24	0.60	0.86
(311) Structure	25	23	33.34	18.94	17.32	8.28
(312) Boiler plant equipment	50	56	58.67	51.03	49.73	31.92
(314) Turbogenerator unit	40	36	35.09	36.43	34.54	32.36
(315) Accessory elec equipment	8	7	11.08	8.13	6.21	4.27
(316) Misc plant equipment	2	2	2.13	1.61	0.98	0.19
Total station	125	125	141.26	116.38	109.38	77.93
Outdoor switchyard	7	6	5.44	10.99	5.20	6.68
Total, station and switchboard	132	131	146.70	127.37	114.58	84.61
COST OF ENERGY (Mills/net kwhr)						
Fixed charges	0.65	0.563	3.22	.....	2.80	2.02
Computed at	2.84	2.844	12.61	.....	13.5	15
Operating charges	2.22	2.137	3.32	.....	2.75	2.06
Total	2.87	2.700	6.54	.....	5.55	4.08
STATION PERFORMANCE 1958						
Billion Btu used	69,108	62,313	50,028	58,093	35,730	49,179
Fuel cost (¢/million Btu)	17.9	18.79	30.23	17.02	27.7	18.6
Btu/net kwhr send out	9,740	9,310	9,220	9,173	9,086	10,161
Btu/gross kwhr generated	9,200	8,810	8,723	8,759	8,563	9,850
Average boiler efficiency (%)	88.8	88.7	89.4	.....	89.52	83.3
Station thermal eff, net (%)	35.0	36.7	37.02	37.20	37.6	33.4
Station design Btu/net kwhr	10,152	9,294	9,048	.....	8,953	10,109
Employees (oper & mtce) per Mw	0.24	0.16	0.068	.....	0.128	0.065
Plant factor, annual (%)	63.4	76.7	63.0	85.8	87.9	71.5
Utilization factor, annual (%)	99.3	101.8	102.4	103.4	105	103.5

† Numbers continue from previous surveys. Parentheses enclose old numbers of plants since modified.

** Electric plant account numbers prescribed by Federal Power Commission.

* Rating groups (Manufacturer's Maximum Rated Capability) Mw; I, 0—19; II, 20—39; III, 40—59; IV, 60—74; V, 75—99; VI, 100—149; VII, 150—299; VIII, 300—499; IX, 500 up.

57 Modern Steam Stations

393 (244)	394	395	396 (301)	397 (205)	398 (198)	399 (251)	400 (246)
MA	SA	MA	MA	MA	SA	WNC	ENC
1953	1958	1959	1954	1950	1950	1953	1952
1961	1959	1960	1960	1960	1958	1959	1958
IX	IX	IX	IX	IX	IX	IX	VIII
3	3	2	4	4	5	3	4
VII, VIII	IX	VIII	VI, VII	V, VII	VI	VI, VII	VI, VII
3	3	2	4	4	5	3	4
1,350 & 2,400	1,523	2,000	894 & 1,200	670 & 1,470	950 & 975	925 & 1,850	706–1,100
1,850 & 2,150	2,075	5,300	2,080 & 2,500	1,650 & 2,700	1,250 & 1,800	1,450 & 2,150	1,450–2,400
1,000 & 1,050	1,050	1,210	1,050	1,000 & 1,050	950 & 1,000	950 & 1,010	1,000 & 1,050
1,000	1,050	1,050	1,000	1,000	1,000	950 & 1,010	1,000
35–75	33–85	36–85	36–94	34–74	70–82	32–81	37–83
.....	0.7–2.4	0.65–2.40	0.87–4.78	0.35–1.75	.....	1.0–2.3	0.82–2.35
76.5	144	100	.....	80	200	360	325
.....	139	60	156	27.1	200	100	159
1,500,000	700,000	300,000	175,000	200,000	500,000	500,000	500,000
260,000	1,190	25,000	595	.....	.....	.....	.....
201	157	95	120	160	165	264	160
31	.....	21	16	13	14	36	30
146	.....	36	42	68	71	67	45
.....	.....	15	47	32	34	110	46
8	.....	4	3	14	2	7	13
16	.....	13	8	16	14	21	19
0	.....	6	4	17	30	23	17
4,275.88	4,835	1,553.7	4,318	2,604	3,320	4,075	3,365
4,069.92	4,655	1,414.9	4,071	2,502	3,157	3,848	3,156
732	717	317.3	628	611	635	545	491.5
15	9.67	35.3	9.4	22.8	6.14	12.8	9.42
Coal, Oil, Gas	Coal	Coal	Coal	Coal	Coal & Gas	Coal & Gas	Coal
1,255,389	1,784,970	458,000	1,553,030	867,769	753,700	1,507,279	1,353,188
13,600	12,057	13,580	12,622	13,491	12,596	11,262	11,407
.....	12.2, 7.5	7.5, 3.2	12.20	7.7, 4.5	8.24, 6.19	10.1, 11.15	12.96, 9.34
36.35	20.02	35	19.76	30.5	28.59	21	20.4
12,364	.....	60,000	.....	.....	.....	.....	.....
148,822	.....	145,400	.....	.....	.....	.....	.....
35.22	.....	53.9	.....	.....	.....	.....	.....
4,674,515	.....	.....	.....	.....	13,730,571	4,358,217	.....
1,054	.....	.....	.....	.....	1,030	1,057	.....
38.96	.....	.....	.....	.....	28.20	20.34	.....
0.28	.....	.....	0.14	0.27	.....	0.40	0.233
0.09	.....	.....	0.04	0.03	.....	.....	0.072
0.41	.....	.....	0.28	0.21	.....	0.42	0.294
0.78	0.37	.....	0.46	0.51	0.22	0.82	0.599
3.63	1.84	.....	1.93	3.13	2.99	2.10	1.992
4.41	2.21	.....	2.39	3.64	3.21	2.92	2.591
0.93	0.16	4.38	0.15	0.84	0.04	0.25	0.25
45.71	24.40	44.08	22.73	27.42	15.29	29.40	40.36
82.98	52.81	113.94	64.40	58.90	41.34	66.80	64.03
39.16	36.51	52.00	39.60	43.41	36.85	44.30	38.09
26.42	9.02	13.09	10.40	5.18	5.05	14.70	10.46
2.62	2.12	2.01	2.18	1.57	0.63	1.10	1.74
197.82	125.02	229.50	139.46	137.32	99.20	156.55	154.93
.....	9.28	8.55	11.57	7.55	4.95	4.55	9.43
.....	134.30	238.05	151.03	144.87	104.15	161.10	164.36
4.89	.....	.....	.....	3.82	2.74	3.31	3.804
14	.....	.....	.....	14	13.75	15	15.0
4.41	.....	.....	2.39	3.64	3.20	2.92	2.591
9.30	.....	.....	.....	7.46	5.94	6.23	6.395
39,151.8	42,805	12,831	39,205	23,400	33,145	20,573	30,871
36.68	20.03	35.6	19.94	30.5	28.44	20.91	20.4
9,620	9,196	9,068	9,665	9,350	10,498	10,024	9,787
9,156	8,854	8,258	9,110	8,980	9,983	9,458	9,171
88	.....	89.6	88.7	89.88	86	86.3	89.75
35	37.11	37.6	35.3	36.5	32.51	34	34.86
8,959	.....	8,133	9,150	9,245	10,350	9,700	9,450
.....	.....	0.106	0.14	0.266	3.8	0.50	0.146
62.6	76.8	47.5	81.0	79.5	59.7	80.8	73.71
100.0	103.9	93.6	102.1	101.0	115.27	109	100.92

Additional information (listed by station number)

387, 388 Fixed charges computed at percentage that is composite of percentages applied to individual items of investment

393 Coal and oil storage capacity includes some system storage

400 Maintenance employees include 10 results and instrument section personnel

Cost and Performance Data of

STATIONS NUMBERS †	401 (212)	402	403	404	405 (257)	406 (306)
GENERAL DATA						
Location	WSC	SA	WSC	MA	SA	WNC
Year, first operation	1950	1958	1959	1947	1953	1952
newest unit	1959	1958	1960	1959	1959	1959
Total net plant capability*	VIII	VIII	VIII	VIII	VIII	VIII
No. of turbogenerators	4	2	3	2	3	4
Range of unit ratings*	III–VII	VII	VI, VII	II, VIII	VI, VII	III–VI
No. of boilers	4	2	3	2	3	4
Range of ratings (M lb/hr)	510–1,680	1,523	700 & 1,100	120 & 2,400	750 & 1,170	425 & 800
Steam pressure (psi)	850–2,000	2,075	1,600 & 1,981	900 & 2,150	1,500 & 2,450	1,350 & 1,925
Steam temp, initial supht (F)	900 & 1,000	1,050	1,000	900 & 1,050	1,000	425 & 1,005
reheat (F)	1,000	1,050	1,000	1,000	1,000	1,005
Cooling water range (F)	61–91	55–85	70–93	35–85	40–85	51–99
Corresponding vacuum (in. Hg)	1.39–3.26	1.1–2.6	29.15–27.20	.....	0.92–0.29	0.55–3.72
Plant site area (acres)	270	450	.....	148	257	.....
In use (acres)	100	138	400	.....	169	200
Fuel storage, coal (tons)	100,000	350,000	.....	170,000	200,000	.....
Oil (bbl)	14,400	1,190	20,000	24,600	227,00	235,000
Employees, total	77	126	46	145	109	52
Supervision	4	.....	14	20	13	3
Operation	38	.....	14	57	42	32
Maintenance	29	.....	11	31	26	13
Clerical, stores	3	.....	1	6	5	4
Fuel handling	0	.....	.....	13	12	.....
Guards, laborers	3	.....	6	18	11	.....
OUTPUT DATA						
Total gross gen (kwhr x 10^6)	2,283.277	3,695	1,657.4	2,006	1,993.339	2,270.583
Total net gen (kwhr x 10^6)	2,151.206	3,562	1,573.6	1,928	1,872.137	2,148.151
Maximum 1-hr peak (Mw)	416	476	370	383	371	354.2
Unit hours unavailable—% of total	11.3	7.07	13.4	15	5.6	1.4
FUEL CONSUMPTION						
Primary fuel	Gas	Coal	Gas	Coal, Oil	Coal	Gas, Oil
Coal (tons)	69,720	1,230,000	.....	649,951	671,184	.....
Btu/lb	12,971	12,990	.....	13,538	13,824	.....
Ash (%), Moisture (%)	.....	11.2, 5.0	.....	6.80–3.19	6.4–3.8	.....
Cost (¢/million Btu)	32.3	17.19	.....	35.87	31.6	.....
Oil (bbl)	315,595	1,800	3,067	136,218	95,000	18,822
Btu/gal	148,775	137,300	140,016	148,653	140,000	151,577
Cost (¢/million Btu)	65.1	86.38	3.73	35.64	70	18.35
Gas (M cu ft)	20,531,106	.....	15,498,000	.....	.....	21,223,997
Btu/cu ft	1,149	.....	1,091	.....	.....	1,039
Cost (¢/million Btu)	14.9	.....	23.80	.....	.....	18.07
OPERATING COSTS (Mills/net kwhr)						
Wages (incl supervision)	0.1198	.....	0.14	0.33	0.20	0.10
Water, lubrication, supplies	0.0743	.....	0.04	0.16	0.05	0.05
Maintenance and Repair	0.1686	.....	0.09	0.42	0.20	0.12
Total, oper & mtce (excl fuel)	0.3627	0.290	0.27	0.91	0.45	0.27
Fuel	1.4984	1.545	2.35	3.48	3.15	1.87
Total operation (incl fuel)	1.8611	1.834	2.62	4.39	3.60	2.14
INVESTMENT DATA (Dollars/kw)						
**(310) Land	0.51	0.14	1	1.98	0.58	0.19
(311) Structure	13.72	21.34	8	64.43	23.82	14.72
(312) Boiler plant equipment	43.95	58.12	38	87.63	57.93	38.81
(314) Turbogenerator unit	40.45	41.83	52	43.84	42.38	34.40
(315) Accessory elec equipment	6.78	9.05	12	27.08	8.49	7.77
(316) Misc plant equipment	0.66	2.13	2	2.27	1.03	0.43
Total station	106.07	132.61	114	27.67	134.23	96.32
Outdoor switchyard	6.63	6.03	7	.....	7.57	5.20
Total, station and switchboard	112.70	138.64	121	.....	141.80	101.52
COST OF ENERGY (Mills/net kwhr)						
Fixed charges	3.39	.....	0.37	6.18	3.26	2.58
Computed at	14	.....	.....	14	11.7	15
Operating charges	1.86	.....	2.62	4.39	3.60	2.14
Total	5.25	.....	2.99	10.57	6.86	4.72
STATION PERFORMANCE 1958						
Billion Btu used	21,619	31,966	16,908	18,448.7	18,613	22,181
Fuel cost (¢/million Btu)	14.91	17.22	23.8	35.86	31.6	18.13
Btu/net kwhr send out	10,050	8,975	10,754	9,568	9,942	10,326
Btu/gross kwhr generated	9,469	8,651	10,105	9,192	9,337	9,769
Average boiler efficiency (%)	84.6	.....	84	89.2	90	86.4
Station thermal eff, net (%)	34.8	38.02	32	35.7	34.3	33.1
Station design Btu/net kwhr	.....	.....	10,039	.....	9,370	10,598
Employees (oper & mtce) per Mw	0.167	.....	0.09	.....	0.30	0.125
Plant factor, annual (%)	53	90.1	52	58.1	58.1	67.3
Utilization factor, annual (%)	90	105.7	96	100.0	100.8	97.3

† Numbers continue from previous surveys. Parentheses enclose old numbers of plants since modified.

** Electric plant account numbers prescribed by Federal Power Commission.

* Rating groups (Manufacturer's Maximum Rated Capability) Mw; I, 0—19; II, 20—39; III, 40—59; IV, 60—74; V, 75—99; VI, 100—149; VII, 150—299; VIII, 300—499; IX, 500 up.

57 Modern Steam Stations

407	408	409	410	411	412 (281, 315)	413	414 (314)
MA	WNC	ENC	WSC	WSC	WSC	WNC	MA
1958	1958	1959	1950	1958	1953	1954	1955
1959	1960	1960	1959	1959	1959	1959	1958
VIII	VIII	VIII	VIII	VIII	VIII	VII	VII
2	2	2	5	2	3	3	2
VII	VII	VII	II–VII	VII	IV, VII	VII	VI
2	2	2	5	2	3	3	2
1,260	1,260	1,250	220–1,200	1,200	630 & 1,100	575 & 750	900
1,965	1,925	2,400	920–2,020	1,935	875 & 1,875	1,550 & 1,900	1,900
1,010	1,005	1,050	905–1,000	1,005	910 & 1,005	1,000	1,005
1,010	1,005	1,000	1,000	1,005	1,005	1,000	1,005
36–80	40–90	34–84	40–89	45–98	63.8–81.4	32–85	39–70
1.0–2.9	.....	0.75–2.76	0.85–1.63	0.94–2.72	0.6–1.3	0.65–1.5	0.40–1.66
31	100	92	.....	3,887	105	105	138
20	3,954	92	20	3,887	90	65	29
300,000	1,000,000	.....	.....	0	.....	350,000	200,000
.....	1,000	.....	59,000	55,000	20,000	0	1,091
54	90	78	63	41	56	51	77
8	12	26	5	3	2	6	12
16	37	18	34	24	35	26	30
10	26	18	18	11	12	12	19
3	5	5	4	1	1	0	6
8	7	10	0	0	.....	6	6
9	3	1	10	2	6	1	4
2,627.520	1,844	2,063.4	1,016.6	2,338.707	1,096	1,696	1,793
2,497.935	1,720	1,947.7	951.9	2,250.773	1,029	1,613	1,696
357	331	365	303.7	341.2	242	293.4	292
6.6	13.4	13.30	96.66	0.48	3.8	0.40	9.92
Coal	Coal	Coal	Gas	Gas	Gas (Oil)	Gas, Coal	Coal
1,059,052	8,064,890	744,625	.....	.....	.....	172,754	642,898
11,590	10,114	12,264	.....	.....	.....	12,018	12,346
14.3–6.5	19.3–10.2	11.3–5.0	.....	.....	.....	10.7–8.0	11.57–6.27
16.87	20.34	17.49	.....	.....	.....	30.9	32.06
.....	7,338	.....	1,054	.....	.....	.....	2,915
.....	138,000	.....	142,857	.....	19,000	.....	137,141
.....	70.38	.....	38.51	.....	.....	.....	82.66
.....	.....	.....	9,175,509	20,220,000	10,322,000	12,076,177	.....
.....	.....	.....	1,190	1,049	1,040	1,007	.....
.....	.....	.....	15.14	18.6	19	26.3	.....
0.09	0.31	0.15	0.33	0.10	0.210	0.10	0.17
0.03	0.07	0.05	0.06	0.01	0.103	0.10	0.05
0.18	0.31	0.20	0.15	0.09	0.116	0.20	0.24
0.30	0.69	0.40	0.54	0.20	0.429	0.40	0.46
1.71	2.05	1.64	1.74	1.93	1.986	2.8	3.03
2.01	2.74	2.04	2.28	2.13	2.42	3.2	3.49
0.35	2.85	1.17	2.12	2.91	0.27	2.75	0.28
21.85	7.75	38.71	16.09	9.51	9.07	27.65	27.08
57.98	63.87	68.91	38.39	31.19	30.64	58.00	57.75
34.79	85.25	50.62	36.34	32.61	40.92	49.37	34.47
7.62	6.65	10.53	6.69	5.06	6.78	10.46	10.33
1.89	1.13	1.77	0.57	0.35	1.07	0.63	1.62
124.48	117.50	171.71	100.20	81.63	88.75	148.86	134.53
5.69	3.56	6.33	1.93	6.19	11.14	8.74	7.92
130.17	121.06	178.04	102.13	87.82	99.89	157.60	142.45
2.12	3.70	.....	5.12	1.93	3.62	2.01	3.09
11.22	15.0	.....	13	15	12.5	7	14.5
2.01	2.74	2.04	2.28	2.13	2.42	3.18	3.50
4.13	6.44	.....	7.40	4.06	6.04	5.19	6.59
24,549	17,334	18,264	10,928	23,309	10,735	16,406	15,919
17.36	20.4	17.49	15.15	18.6	19	27.51	32.06
9,830	10,176	9,377	11,480	10,356	10,400	10,163	9,374
9,343	9,490	8,852	10,750	9,960	9,800	9,673	8,865
85.5	88.0	88.66	85.1	82.5	80	86.8	89.92
34.7	33.5	36.4	29.7	33.0	32.8	33.6	36.40
9,600	9,875	8,930	.....	10,200	8,060	10,000	9,294
0.15	0.26	0.225	0.16	0.106	0.188	0.16	0.25
78.6	59.5	804.1	32.5	77.8	57.0	62.3	74.39
98.6	94.6	105.49	91.2	103.2	81	98.7	99.67

Additional information (listed by station numbers)

404 Coal storage capacity is principally system storage facilities

409 26-man supervisory force includes technical personnel

409 Except for plant factor, station performance data includes preliminary operation of Unit 2 a 173 Mw unit put in commercial operation July 1, 1960

Cost and Performance Data of

STATION NUMBERS †	415	416 (313)	417 (221)	418	419	420
GENERAL DATA						
Location	SA	ENC	MA	ENC	ESC	Mt
Year, first operation	1956	1955	1951	1959	1950	1960
newest unit	1959	1959	1959	.....	1959	1960
Total net plant capability*	VII	VII	VII	VII	VII	VII
No. of turbogenerators	2	2	3	1	4	2
Range of unit ratings*	VI	VI	IV, VI	VII	II–VI	VI
No. of boilers	2	2	3	1	5	2
Range of ratings (M lb/hr)	950	950	500 & 950	1,750	215–750	835
Steam pressure (psi)	2,075 & 1,875	2,000	1,650 & 2,400	2,500	875 & 1,525	2,000
Steam temp, initial supht (F)	1,000	1,050	1,000 & 1,050	1,050	905–1,000	1,000
reheat (F)	1,000	1,000	1,000	1,050	1,000	1,000
Cooling water range (F)	33–84	35.7–77.4	32–85	33–85	36–85	89–56
Corresponding vacuum (in. Hg)	0.70–2.22	0.53–1.52	0.5–2.0	0.80–1.90	28–27	2.83–1.50
Plant site area (acres)	116	285	60	1,000	300	320
In use (acres)	65	133	40	.....	50	160
Fuel storage, coal (tons)	100,000	425,000	100,000	800,000	300,000	.....
Oil (bbl)	1,190	367	.....	.....	.....	55,000
Employees, total	72	77	108	62	83	40
Supervision	2	5	11	19	4	9
Operation	29	32	41	24	47	22
Maintenance	15	17	27	7	16	8
Clerical, stores	2	4	6	3	2	1
Fuel handling	11	10	12	9	10	0
Guards, laborers	13	9	11	4	4	0
OUTPUT DATA						
Total gross gen (kwhr x 10^6)	1,849.79	1,922.5	1,525	1,691	1,480	.....
Total net gen (kwhr x 10^6)	1,841.40	1,812.6	1,422	1,592	1,393	1,192
Maximum 1-hr peak (Mw)	276	269	262	273.8	.....	233
Unit hours unavailable—% of total	5.26	9.467	.....	14.88	.....	12
FUEL CONSUMPTION						
Primary fuel	Coal	Coal	Coal	Coal	Coal	Gas
Coal (tons)	657,130	687,731	494,926	605,000	647,775	.....
Btu/lb	13,552	12,257	13,180	12,015	11,779	.....
Ash (%), Moisture (%)	7.5–3.6	11.8–4.8	8–3.5	11.38–7.0	.....	.....
Cost (¢/million Btu)	34.34	29.02	33.9	32.94	.....	.....
Oil (bbl)	3,225	4,044	13,099	.....	.....	.....
Btu/gal	138,630	137,979	138,000	.....	.....	.....
Cost (¢/million Btu)	45.08	77.63	77.5	.....	.....	.....
Gas (M cu ft)	.....	.....	714,132	.....	.....	10,749,236
Btu/cu ft	.....	.....	1,025	.....	.....	1,082
Cost (¢/million Btu)	.....	.....	31.7	.....	.....	32.95
OPERATING COSTS (Mills/net kwhr)						
Wages (incl supervision)	0.28	0.08	0.32	0.35	0.28	0.15
Water, lubrication, supplies	0.06	0.23	0.06	0.05	0.06	0.13
Maintenance and Repairs	0.22	0.39	0.36	0.08	0.24	0.12
Total, oper & mtce (excl fuel)	0.56	0.70	0.74	0.44	0.58	0.40
Fuel	3.32	2.71	3.34	3.06	1.82	3.09
Total operation (incl fuel)	3.88	3.41	4.08	3.54	2.40	3.493
INVESTMENT DATA (Dollars/kw)						
**(310) Land	0.71	3.01	0.67	0.66	0.10	.....
(311) Structure	44.79	33.90	38.11	31.00	28.60	.....
(312) Boiler plant equipment	58.39	66.50	78.54	66.94	54.00	.....
(314) Turbogenerator unit	36.92	40.15	54.11	46.81	37.40	.....
(315) Accessory elec equipment	15.24	9.70	14.33	5.75	7.45	.....
(316) Misc plant equipment	1.22	1.10	1.10	0.60	1.45	.....
Total station	157.27	154.36	186.86	151.76	129.00	.....
Outdoor switchyard	2.48	7.95	7.53	5.74	11.50	.....
Total, station and switchboard	159.75	162.31	194.39	157.50	140.50	.....
COST OF ENERGY (Mills/net kwhr)						
Fixed charges	3.461	3.61	5.26	3.40	2.33	.....
Computed at	14.56	12.5	14.5	14.3	12.87	.....
Operating charges	3.881	3.41	4.05	3.54	2.40	3.49
Total	7.342	7.02	9.31	6.94	4.73	.....
STATION PERFORMANCE 1958						
Billion Btu used	17,830	16,883	13,730	14,583	15,261	11,619
Fuel cost (¢/million Btu)	34.35	29.09	33.1	32.94	16.0	32.95
Btu/net kwhr send out	9,683	9,314	9,628	9,160	10,948	9,749
Btu/gross kwhr generated	9,145	8,782	8,998	8,623	10,301	.....
Average boiler efficiency (%)	89.6	90.01	.....	90.0	.....	86.7
Station thermal eff, net (%)	35.2	36.64	35.4	37.3	31.2	35
Station design Btu/net kwhr	9,700	9,250	9,050	8,930	.....	9,910
Employees (oper & mtce) per Mw	0.161	0.1815	0.4	0.17	0.25	0.17
Plant factor, annual (%)	85.9	76.63	58.0	73	54.2	69.2
Utilization factor, annual (%)	100.0	99.63	93.5	109.5	.....	101.56

† Numbers continue from previous surveys. Parentheses enclose old numbers of plants since modified.

** Electric plant account numbers prescribed by Federal Power Commission.

* Rating groups (Manufacturer's Maximum Rated Capability) Mw; I, 0—19; II, 20—39; III, 40—59; IV, 60—74; V, 75—99; VI, 100—149; VII, 150—299; VIII, 300—499; IX, 500 up.

57 Modern Steam Stations

421 (372)	422 (325)	423	424	425	426	427	428 (226)
Mt	NE	WSC	NE	WSC	SA	WNC	SA
1957	1954	1959	1960	1960	1958	1958	1952
1959	1958	.....	.....	.....	.....	1960	1958
VII	VII	VII	VII	VII	VII	VI	VI
2	2	1	1	1	1	2	2
VI	IV, VI	VII	VII	VII	VII	IV	III, IV
2	2	1	1	1	1	2	2
852	600, 800	1,200	1,150	1,100	1,100	500	425 & 575
1,550	1,300 & 1,500	1,935	2,225	1,981	1,625	1,725	875 & 1,800
1,005	950 & 1,005	1,005	1,000	1,000	1,005	1,005	900 & 1,000
1,005	1,005	1,005	1,000	1,000	1,005	1,005	1,000
60–83	35–81	38–87	32–74	43–86	57–89	34–81	68–92
1.30–2.39	0.96–2.16	29.42–25.56	0.85–2.25	29.4–27.6	.....	0.60–1.75	29.00–27.00
130	114	1,960	116.5	.....	400	200	200
70	38	1,960	45	572.93	40	120	75
700,000	200,000	.....	69,500	.....	.....	200,000	90,000
.....	55,000	55,000	.....	28,000	100,000	.....	225,000
54	78	60	57	24	48	40	83
10	11	10	2	9	3	4	10
24	39	26	31	5	29	21	33
15	13	12	9	7	14	7	14
2	2	3	2	1	2	1	1
3	9	.....	7	.....	.....	7	7
0	4	9	6	2	.....	.....	18
1,598	1,319	831	1,063	546	818	793	633
1,493	1,251	801	1,002	516	779.092	752	597
222	190	175	166.7	172	159	143.1	134
12.27	.....	30	21.27	5.2	4	0.53	35.75
Coal, Gas	Coal	Gas (Oil)	Coal	Gas	Oil	Coal	Coal
404,722	456,934	.....	362,665	.....	.....	290,980	240,598
9,968	13,439	.....	13,127	.....	.....	12,724	12,763
6–15	7.0	.....	10.2—4–6	.....	.....	.....	11.55–4.97
25.07	37.162	.....	35.01	.....	.....	38.0	33.20
.....	13,720	6,733	3,890	1,879	1,231,164	.....	.....
.....	152,872	146,071	140,000	139,993	150,238	.....	.....
.....	37.630	45.61	71.64	3.76	35.3	.....	.....
9,339,368	.....	7,628,063.6	.....	4,914,990	.....	.....	.....
843	.....	1,062.0	.....	1,124	.....	.....	.....
22.25	.....	17.56	.....	23.99	.....	.....	.....
0.22	0.321	0.31	0.319	0.17	0.25	0.23	.....
0.07	0.052	0.16		0.15	0.06	0.04	.....
0.13	0.261	0.53	0.262	0.11	0.23	0.13	.....
0.42	0.634	1.00	0.581	0.43	0.54	0.40	0.57
2.53	3.670	1.88	3.343	2.30	3.51	3.79	3.42
2.95	4.304	2.88	3.924	2.73	4.05	4.19	4.00
3.43	0.38	.....	6.41	4	1	0.855	1.27
16.92	39.97	23.85	48.40	15.15	21.49	27.350	31.16
74.34	69.48	35.26	70.59	44	39.77	72.979	70.44
52.12	47.45	30.87	45.34	63	32.80	53.241	48.36
11.32	12.51	4.85	10.67	14	6.15	10.743	12.25
0.75	2.93	0.71	2.77	2.5	1.35	1.265	1.62
158.88	172.72	95.54	185.51	143	102.56	166.433	165.10
7.04	8.77	6.45	7.10	9	.....	5.840	7.76
165.92	181.49	101.99	192.61	152	.....	172.273	172.86
2.84	3.18	.....	4.687	.60	3.51	4.48	5.17
11.95	12.5	.....	14.89	.....	17	14	13.75
2.95	4.30	2.88	3.924	2.73	4.05	4.19	4.00
5.79	7.48	.....	8.611	3.33	7.56	8.67	9.17
15,937	12,360	8,142	9,544	5,524	7,769	7,416	.....
23.418	32.253	17.6	35.11	21.42	35.3	38.0	33.26
10,674	9,860	10,163	9,521	10,717	9,971	983.1	10,293
9,969	9,380	9,791	8,974	10,127	9,490	9,346	9,710
89.90	89.0	.....	89.0	84.4	.....	.....	87.5
32.00	34.8	33.6	36.3	32	34.2	34.7	33.16
10,674	9,800	9,920	9,272	9,975	.....	9,710	10,000
0.25	0.28	0.21	0.347	0.1	0.31	0.286	1.4
85.0	77.2	52	70.0	48	56.5	64.05	52.47
103.7	103.0	100	101.5	106	101.3	102.21	116.52

Additional information (listed by station number)

418 Among 19 men in supervisory force 8 have joint responsibility for supervision of other generating equipment at another plant on the site.

Cost and Performance Data of

STATION NUMBERS †	429 (286)	430	431	432	433	434
GENERAL DATA						
Location	WSC	SA	ENC	Pac.	Mt	NE
Year, first operation	1953	1958	1960	1956	1959	1957
newest unit	1959	.....	.....	1958	1960	1958
Total net plant capability*	VI	VI	VI	VI	VI	V
No. of turbogenerators	3	1	1	2	2	2
Range of unit ratings*	II, III	VI	VI	III	III	III
No. of boilers	3	1	1	2	2	2
Range of ratings (M lb/hr)	300 & 350	900	850	475	467.5	445
Steam pressure (psi)	875 & 1,510	1,850	1,840	900	1,500	1,360
Steam temp, initial supht (F)	910 & 1,005	1,000	1,000	900	960	950
reheat (F)	1,005	1,000	1,000	0	.....	.....
Cooling water range (F)	47–82	60–87	32–90	50–70	60–80	30–70
Corresponding vacuum (in. Hg)	29.31–27.84	29.20–27.80	29–27	1.25–2.07	1.0–1.8	0.73–1.80
Plant site area (acres)	128.11	663.88	172	140.95	80	119
In use (acres)	10	682.78	150	.....	30	50
Fuel storage, coal (tons)	.....	.....	2,000	.....	.....	.....
Oil (bbl)	10,000	450,000	.....	135,720	40,000	380,000
Employees, total	33	55	39	45	27	46
Supervision	3	2	8	7	8	4
Operation	19	30	14	22	22	33
Maintenance	10	10	10	13	4	5
Clerical, stores	1	1	1	3	1	1
Fuel handling	0	3	4	.....	.....	.....
Guards, laborers	0	9	2	.....	.....	3
OUTPUT DATA						
Total gross gen (kwhr x 10^6)	609	794	528	391	474	608
Total net gen (kwhr x 10^6)	586	755	498	375	450	581
Maximum 1-hr peak (Mw)	124.5	137	133	109	100.7	102
Unit hours unavailable—% of total	9.9	3.9	9	5.56	12.17	11.16
FUEL CONSUMPTION						
Primary fuel	Gas (Oil)	Gas (Oil)	Coal	Gas (Oil)	Gas	Oil
Coal (tons)	.....	.....	230,000	.....	.....	.....
Btu/lb	.....	.....	10,500	.....	.....	.....
Ash (%), Moisture (%)	.....	.....	11.0–16.8	.....	.....	.....
Cost (¢/million Btu)	.....	.....	22.5	.....	.....	.....
Oil (bbl)	Standby	37,412	.....	17,251	27,894	1,006,881
Btu/gal	149,376	151,000	.....	152,780	154,000	149,519
Cost (¢/million Btu)	0.2222	.....	.....	.....	22.2	36.4
Gas (M cu ft)	5,782,906	7,588,527	.....	5,038,257	4,489,356	.....
Btu/cu ft	1,128.26	1,060	.....	975	1,059	.....
Cost (¢/million Btu)	0.154279	30.8	.....	.....	21.27	.....
OPERATING COSTS (Mills/net kwhr)						
Wages (incl supervision)	0.21	.....	0.25	.....	0.283	0.44
Water, lubrication, supplies	0.08	0.345	0.07	.....	0.063	0.11
Maintenance and Repair	0.14	0.200	0.27	.....	0.138	0.16
Total, oper & mtce (excl fuel)	0.43	0.545	0.59	.....	0.484	0.71
Fuel	1.72	3.374	2.26	.....	2.335	3.96
Total operation (incl fuel)	2.15	3.919	2.84	.....	2.819	4.67
INVESTMENT DATA (Dollars/kw)						
**(310) Land	0.30	11.40	4.87	2.72	1.03	1.40
(311) Structure	13.72	62.00	79.26	15.30	12.57	66.23
(312) Boiler plant equipment	36.84	52.30	83.25	62.03	48.01	56.76
(314) Turbogenerator unit	50.00	43.80	48.09	59.51	65.27	54.62
(315) Accessory elec equipment	7.04	9.70	9.41	8.25	9.85	19.55
(316) Misc plant equipment	1.1	0.80	3.16	3.81	2.47	1.76
Total station	109.09	180.00	228.04	151.62	139.20	200.32
Outdoor switchyard	9.68	7.20	6.98	8.18	11.60	8.30
Total, station and switchboard	118.77	187.20	235.02	159.86	150.80	208.62
COST OF ENERGY (Mills/net kwhr)						
Fixed charges	3.2826	4.373	5.16	.....	3,878	4.69
Computed at	14	14.7	15	.....	15.6	13.60
Operating charges	2.1555	3.919	2.84	.....	2.218	4.67
Total	5.4381	8.292	8.00	.....	6.696	9.36
STATION PERFORMANCE 1958						
Billion Btu used	6,525	.....	48,195	49,302	4,933,704	6,323
Fuel cost (¢/million Btu)	15.4	30.8	22.5	.....	21.3	36.4
Btu/net kwhr send out	11,131	10,364	9,870	13,156	10,949	10,874
Btu/gross kwhr generated	10,720	9,850	9,240	12,607	10,401	10,391
Average boiler efficiency (%)	83.81	.....	87.3	87.6	83.8	84.85
Station thermal eff, net (%)	30.68	34.67	40.4	25.46	30.8	31.41
Station design Btu/net kwhr	11,272	9,534	9,620	11,185	11,000	10,820
Employees (oper & mtce) per Mw	0.26	0.32	0.3	0.44	0.00027	0.48
Plant factor, annual (%)	82.53	74.8	77.8	41.6	72.4	69.2
Utilization factor, annual (%)	54.14	110	105.5	106.3	100.0	106.0

† Numbers continue from previous surveys. Parentheses enclose old numbers of plants since modified.

** Electric plant account numbers prescribed by Federal Power Commission.

* Rating groups (Manufacturer's Maximum Rated Capability) Mw; I, 0–19; II, 20–39; III, 40–59; IV, 60–74; V, 75–99; VI, 100–149; VII, 150–299; VIII, 300–499; IX, 500 up.

57 Modern Steam Stations

435	436	437	438	439	440	441	442	443
ENC	SA	Pac	Mt	WNC	SA	WNC	NE	ESC
1954	1960	1959	1959	1954	1952	1951	1960	1960
1958	.....	.....	1959	1960	1957	1958	.....	.....
V	V	V	II	II	II	I	I	I
2	1	1	3	2	3	2	1	1
III	V	V	I	I, II	I	I	I	I
2	1	1	3	2	3	2	1	1
380 & 430	635	575	139	215 & 130	65 & 165	95 & 125	130	125
1,300	1,850	1,850	620	850 & 600	635 & 850	600	1,300	600
950	1,005	1,000	800	900 & 825	825 & 910	825	950	825
.....	1,005	1,000	.....	.....	.....	.....	.....	.....
32.4-80.0	50-94	90-75	45-72	55-85	77-78	40-90	65-85	66-66
29.54-27.96	0.5-2.5	3-2	23.89-21.80	0.8-2.2	1.8-2.2	0.75-2.0	1.5-2.25	1.2-1.2
14	65	80	76	55	.....	3	15.1	10
14	35	35	25	60	.....	3	4	5
46,000	.....	.....	30,000	.....	.....	10,000	.....	3,000
475	87,800	30,000	.....	30,000	38,096	.....	10,000	.....
81	62	33	24	1	40	27	4	14
7	5	4	1	2	2	4	1	1
57	27	19	9	13	19	15	2	8
5	10	8	6	3	13	4	1	2
1	2	2	.....	.....	2	1	.....	.....
6	6	.....	4	.....	.....	2	.....	.....
5	12	.....	4	.....	4	1	.....	3
473	210	434	148	130	106	52.28	73	30.78
443	197	411	136	121	99.7	48.21	69	28.07
86.0	80	78.1	32	34.5	79.4	12.05	.....	13.0
3.5	11	14	13.3	.....	.....	.....	95.9	2.65
Coal	Oil	Gas	Coal	Gas	Oil	Coal, Gas	Oil	Gas, Coal
188,968	.....	.....	.....	.....	.....	15,095	.....	2,495
12,960	.....	.....	12,400	.....	.....	9,000	.....	12,500
7.58-4.47	.....	.....	14.2-3.54	.....	.....	18-15	.....	7.26-6.41
33.72	.....	.....	18.41	.....	.....	31.0	.....	36.55
1,684	330,286	235	.....	14,070	209,283	.....	131,692	.....
139,606	150,000	145,795	.....	150,000	150,527	.....	150,000	.....
76.75	37.8	48.8	.....	53	39.6	.....	0.3695	.....
.....	.....	3,913,370	.....	1,605,207	.....	478,767	.....	318,000
.....	.....	1,075	.....	955	.....	1,000	.....	1,000
.....	.....	32.6	.....	21.6	.....	27.45	.....	25.41
0.70	0.854	0.649	0.639	.....	1.133	2.612	0.93	1.22
0.04	0.875	0.129	0.145	.....	0.278	0.610	0.11	0.12
0.28	0.360	0.527	0.396	.....	0.590	0.607	0.23	.89
1.02	1.289	1.305	.....	.....	2.001	3.829	1.27	2.23
3.76	4.022	3.341	2.679	.....	5.261	4.451	4.50	4.04
4.78	5.311	4.646	3.954	4.21	7.261	8.280	5.77	6.27
0.10	6.40	0.89	0.65	.....	2.06	.....	3.04	2.26
46.50	89.39	12.15	36.07	.....	36.41	40.0	98.45	71.20
82.80	30.51	57.68	84.09	.....	76.38	45.0	80.89	45.70
53.90	58.54	64.24	69.16	.....	88.17	55.0	88.35	63.10
20.80	5.78	14.83	16.09	.....	22.30	22.0	0.14	17.33
2.00	0.51	2.48	3.61	.....	3.49	43.0	2.68	56.36
206.10	191.13	152.27	209.67	.....	228.81	205.0	273.35	255.95
.....	.....	14.57	21.84	.....	23.78	.....	.....	13.05
206.10	.....	166.84	231.51	.....	252.59	205.0	.....	269.00
0.29	8.247	4.428	3.51	.....	.....	0.280	1.469	7.13
.....	.....	15	.....	.....	.....	3.50	20	3.67
4.78	5.311	4.646	3.95	.....	.....	0.828	5.77	6.27
5.07	13.558	9.074	7.46	.....	.....	1.108	7.239	17.07
4,908	2,081	4,208	.....	1,621.61	1,323	750.5	829	390.4
33.75	37.8	35	18.41	23.36	39.6	36	36.95	27.4
11,052	10,553	10,300	14,680	13,451	13,278	15,567	.....	13,920
10,366	9,902	9,675	13,490	12,512	12,492	14,410	.....	12,720
88.4	87	.....	80	.....	85	80.0	.....	84
30.87	32.4	.....	26.51	.....	86	21.9	.....	27.1
.....	9,600	.....	.....	12,500	.....	.....	.....	13,100
0.94	0.41	.....	0.64	0.51	.....	1.22	.....	0.87
55.7	35	66	45.3	40.4	60	29.35	.....	50.8
95.8	100	100	62.8	105	76	64.25	.....	117.5

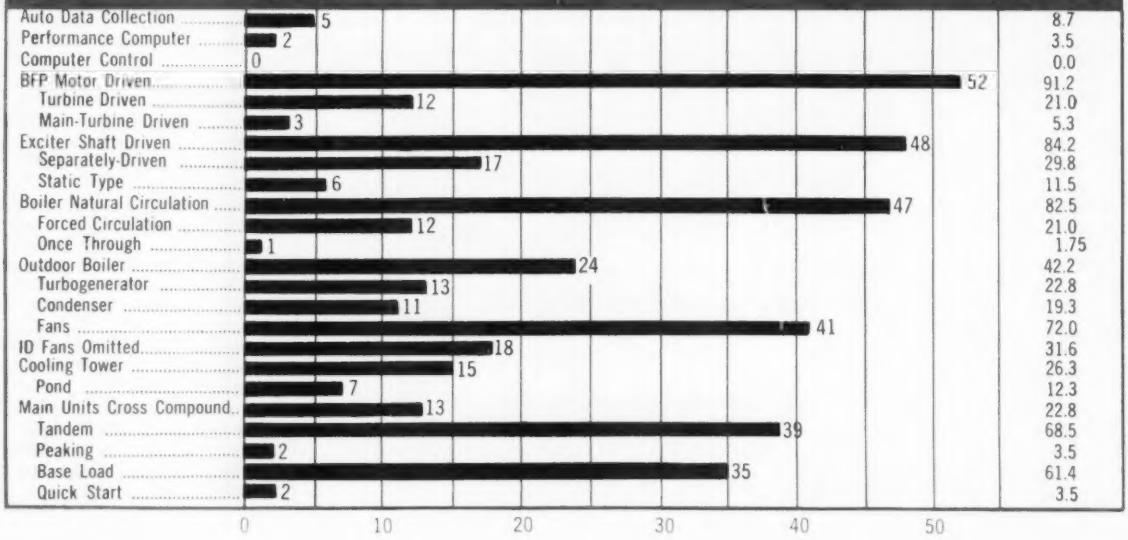
Additional information (listed by station number)

430 Oil storage capacity influenced by fact system fuel oil terminal is at plant site

430 Investment in land and structures (310) and (311) includes cost of deep water oil terminal with 2½ mile canal, dock, heating boilers and piping

434 Plant designed but not equipped for coal as well as oil

Design Features of 57 Reporting Stations



Steam Station Space Factors

BOILER ROOM (CU FT/KW)

Mw Range	Max	Min	Avg
0– 19	39.	5.6	19.
20– 39[1]	4.	.....	.....
40– 59	.....	.....	.....
60– 74	.....	.....	.....
75– 99	21.	16.	18.
100–149	15.6	4.3	8.8
150–299	15.3	3.2	12.0
300–499	16.6	4.6	11.0
500 & up	21.2	5.1	12.7

TURBINE ROOM (CU FT/KW)

Mw Range	Max	Min	Avg
0– 19	42.	8.1	20.
20– 39[1]	12.	.....	.....
40– 59	.....	.....	.....
60– 74	.....	.....	.....
75– 99	8.5	7.8	8.1
100–149	16.7	1.0	6.1
150–299	9.9	2.7	6.6
300–499	8.7	2.1	5.7
500 & up	10.8	2.2	6.7

BUILDING, GROUND AREA (SQ FT/KW)

0– 19	13.	1.	9.
20– 39[1]	0.6	.....	.....
40– 59	.....	.....	.....
60– 74	.....	.....	.....
75– 99[1]	0.3	.....	.....
100–149	0.89	0.18	0.37
150–299	0.40	0.03	0.24
300–499	1.10	0.02	0.25
500 & up	0.97	0.01	0.25

OFFICE (CU FT/KW)

0– 19	1.	0.8	0.9
20– 39[1]	2.	.....	.....
40– 59	.....	.....	.....
60– 74	.....	.....	.....
75– 99	0.3	0.3	0.3
100–149	1.52	0.20	0.70
150–299	2.58	0.04	0.91
300–499	0.64	0.12	0.34
500 & up	1.60	0.09	0.85

SWITCHHOUSE (CU FT/KW)

0– 19[1]	0.6	.....	.....
20– 39[1]	0	.....	.....
40– 59	.....	.....	.....
60– 74	.....	.....	.....
75– 99	1.5	0.2	0.7
100–149	0.55	0.04	0.28
150–299	1.82	0	0.41
300–499	0.05	0.05	0.05
500 & up	0.21	0	0.09

SWITCHYARD (SQ FT/KW)

0– 19[1]	1.3	.....	.....
20– 39[1]	5.4	.....	.....
40– 59	.....	.....	.....
60– 74	.....	.....	.....
75– 99[1]	0.5	.....	.....
100–149	0.67	0.23	0.45
150–299	0.81	0.16	0.40
300–499	0.37	0.10	0.22
500 & up	0.55	0.09	0.27

FUEL STORAGE AREA (SQ FT/KW)

0– 19	4.	0.1	1.9
20– 39[1]	2.7	.....	.....
40– 59	.....	.....	.....
60– 74	.....	.....	.....
75– 99[1]	4.2	.....	.....
100–149	3.70	0.40	2.6
150–299	3.00	0.13	1.03
300–499	2.80	0.61	1.09
500 & up	1.37	0.36	0.82

[1] One station reported

COAL STORAGE (TONS/KW)

0– 19[1]	0.3	.....	.....
20– 39[1]	0.8	.....	.....
40– 59	.....	.....	.....
60– 74	.....	.....	.....
75– 99	.....	.....	.....
100–149	1.43	0.42	0.85
150–299	3.05	0.36	1.05
300–499	1.03	0.22	0.61
500 & up	1.84	0.28	0.70

[1] One station reported

Chart Shows % Voltage Drop at 12,470 V

EVERETT W. ARNDT, Electrical Engineer, Idaho Power Co, Boise, Idaho*

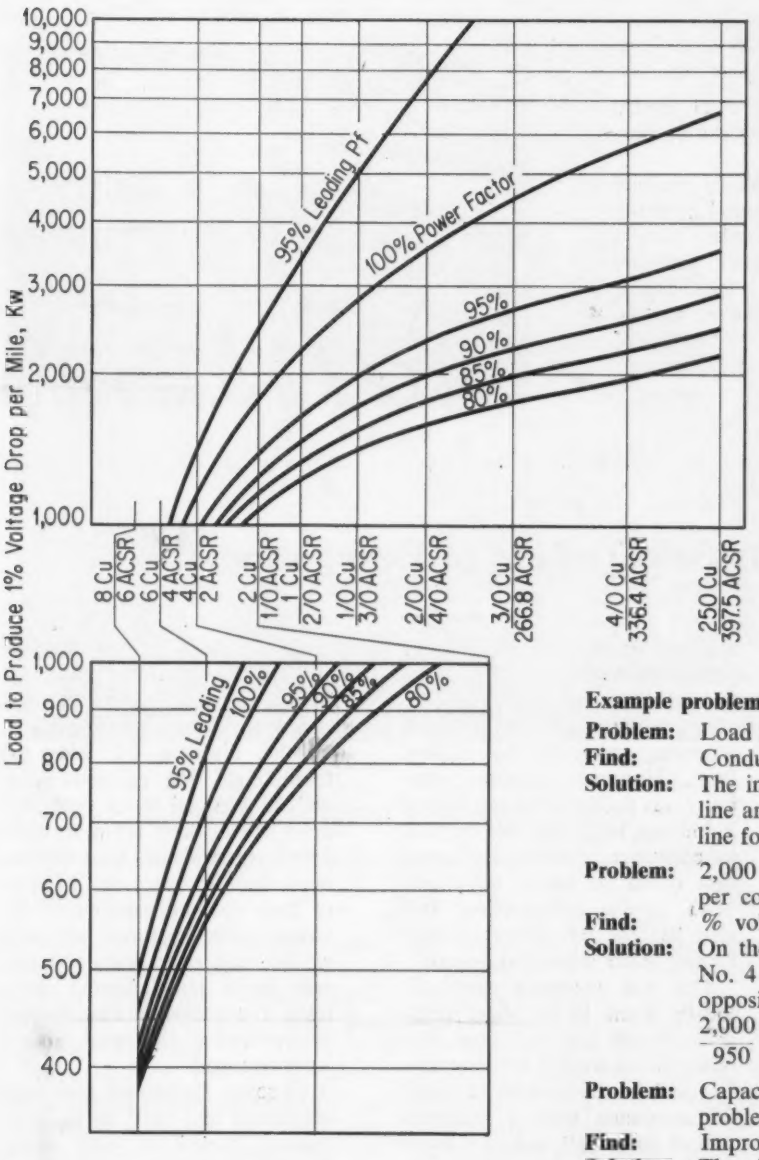
This chart relates percent voltage drop, load and wire size for quickly estimating the performance of 12,470-v grounded wye feeders. Equivalent spacing for three-phase distribution primaries is 53 in. The potential of 12,470 v is the average between sending and receiving ends.

The ordinate scale shows the loads for 1% voltage drop. For ½% voltage drop per mile, multiply the true load by two and enter the chart with this new value to find wire size. For 2% drop, divide by two. In finding voltage drop from known wire size and load, reverse the process, as in the second example problem.

The chart can be used for other than three-phase feeders by applying these load multipliers:

	Load Multiplier
For 2 phases and 1 neutral	1.6
For 1 phase and 1 neutral (actual phase-to-neutral spacing of 66 in.)	
With 10% return current in neutral	3.3
With 25% return current in neutral	3.75
With 50% return current in neutral	4.5
With 100% return current in neutral	6.0

To apply these multipliers when finding percent voltage drop, find the voltage drop for the three-phase case and multiply by the multiplier. When entering with a known load, multiply the actual load by the multiplier, then complete the solution as though it were a three-phase problem.



Example problems:

Problem: Load 2,000 kw at 95% lagging pf
Find: Conductor for 1% voltage drop
Solution: The intersection of the 2,000-kw horizontal line and the 95% curve falls on the vertical line for No. 1/0 copper and No. 3/0 ACSR

Problem: 2,000 kw load, 95% lagging pf, No. 4 copper conductor
Find: % voltage drop per mile
Solution: On the lower chart, the intersection of the No. 4 copper line and the 95% curve falls opposite 950 kw. The voltage drop is $\frac{2,000}{950} = 2.1\%$ per mile

Problem: Capacitors are added to bring the second problem pf to 100%
Find: Improvement in voltage drop
Solution: The intersection of No. 4 copper line and 100% curve falls opposite 1,100 kw. Improvement is $2.1 - \frac{2,000}{1,100} = 0.3\%$

*Mr. Arndt is now with Lockheed Aircraft Corp, Mountain View, Calif.

ELECTRIC UTILITY METHODS

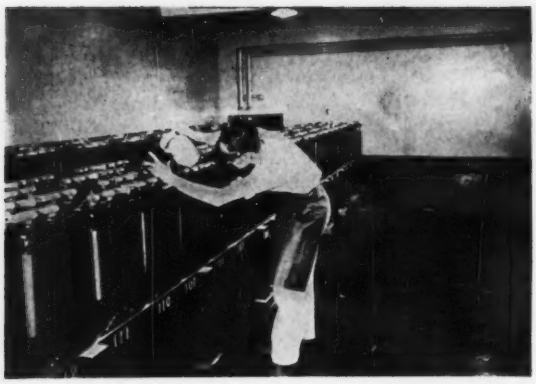
Eum

SAFETY

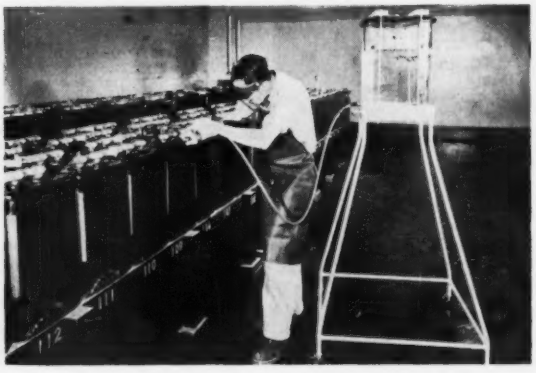
Portable Rig Minimizes Hazards in Battery Servicing

At Tennessee Valley Authority's Pickwick Hydro Plant, a safer, quicker method of filling station batteries is now being used.

Formerly, the water was drawn from a distilled water tank into a pitcher and then poured carefully into the batteries, with the aid of a funnel. Now a container, made from an old battery jar and equipped with a length of small hose, is fitted onto a portable frame which can readily be moved next to the bank of batteries being serviced. On the end of the hose a thumb-controlled, valved spout permits precise control of the battery-filling operation.



PITCHER AND FUNNEL called for awkward, hazardous setup; portable battery jar smooths out filling routines



Portable Cage Permits Safe Testing of Extinguishers

RICHARD ELSEN, Division Construction Engineer—Substations, Indiana & Michigan Electric Co, South Bend, Ind.—AEP System

Hydro static tests of fire extinguishers must be made at pressures of 300 to 350 psi, and even though every effort is made to remove air, some can become entrapped and create a hazard during testing. Therefore, some kind of effective shielding is needed to protect the operator and nearby equipment should an extinguisher burst.

Normally, protection will be afforded by heavy wire mesh screening supported by a steel form. However, because portability was desirable for our testing in remote locations, we decided to construct a sturdy enclosure that could be taken anywhere. With careful construction, this also has the advantage of containing water when leaks occur.

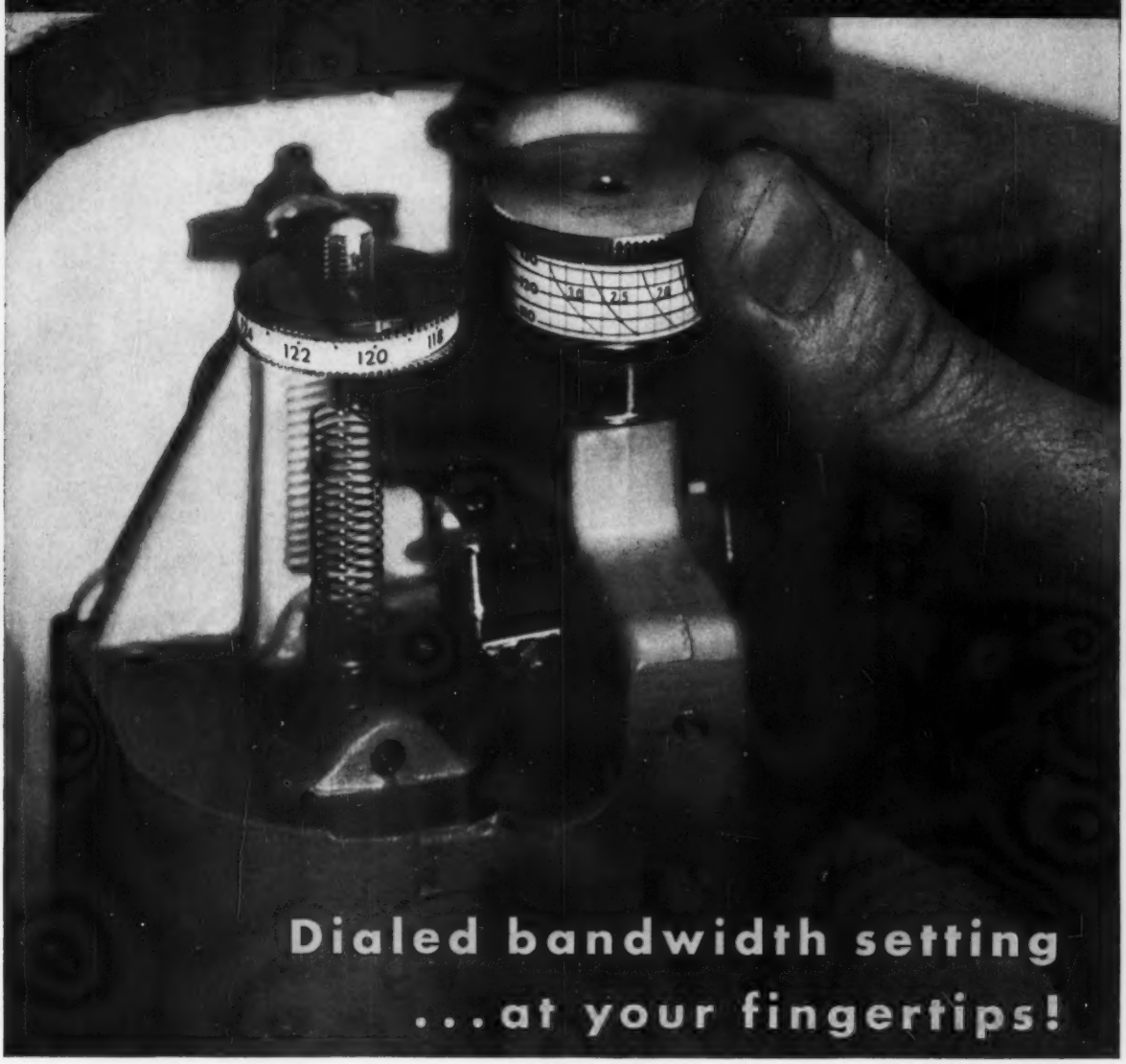
Our test enclosure was built locally from ⅛-in. sheet steel, with hinged top and door and otherwise of welded construction. It could be reproduced in about 20 manhours with a materials cost of about $40, or less, if using surplus or scrap items. The convenience of portability (weight about 150 lb) saves much time.

The enclosure has proved invaluable for this work. It has insured the safety of the operator and nearby apparatus under all conditions. It has now been used to test all of the fire extinguishers in the division—51 2½ gal foam, eight 2½ gal soda acid, and 34 2½ gal water type. Almost half of these are more than 20 years old, and at least five are more than 30 years old. In spite of their age, we experienced no violent tank ruptures, although we did have some leaks and several hoses failed during these tests. The enclosure was effective in containing the water when leaks occurred.

Obsolete 10-gal milk cans were purchased and used to facilitate mixing chemicals with warm water for use in remote locations where warm water was not available, so that the extinguishers could be recharged after testing.

WIRE-MESH GLASS in door allows observation of tank during test

ANOTHER STEP AHEAD IN VOLTAGE REGULATION



G-E Micro-Band* relay: first to permit fast, accurate setting of both regulator voltage level and bandwidth

Now, with General Electric single- and three-phase step voltage regulators, you can dial optimum voltage level *and* bandwidth *in seconds . . . with micrometer accuracy!*

This important new advantage results from G.E.'s Micro-Band voltage-regulating relay—the first in the industry to offer you a dialed calibration of *both* these vital adjustments.

Micro-Band relay saves you time and money by eliminating the guesswork and painstaking procedures normally involved in making regulator adjustments. What's more, this *full* calibration permits precise coordination of voltage level and bandwidth setting with General Electric's highly flexible time-delay control. Thus, you take full advantage of the reduced bandwidths possible with General Electric regulators—bandwidths proven by recent computer studies to offer you increased system earnings at no sacrifice of regulator life.

Your General Electric regulator representative has complete information on the new Micro-Band relay and can show you how to achieve system savings through reduced regulator bandwidths. Call him today. Or write General Electric Company, Section 456-08, Schenectady 5, N. Y. *Voltage Regulator Products Section, Pittsfield, Mass.*

* Trade-mark of General Electric Co.

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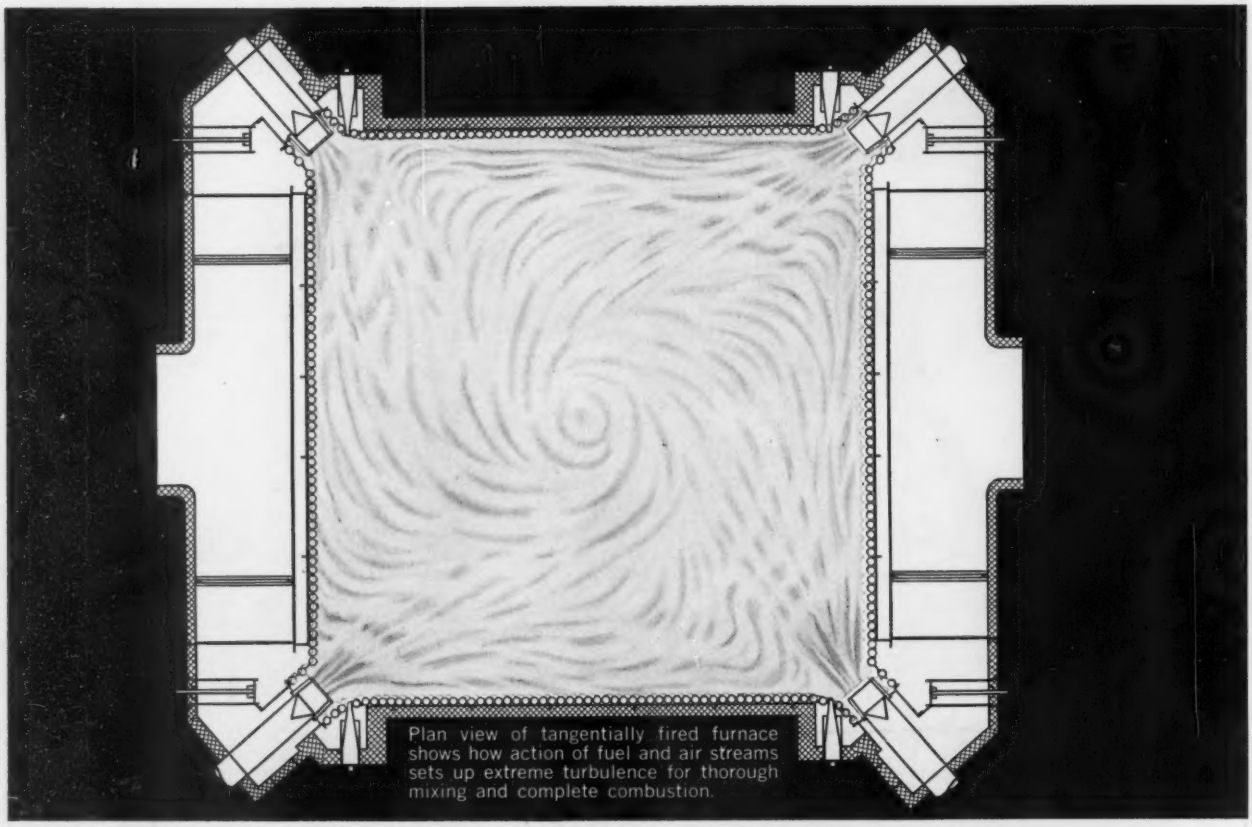
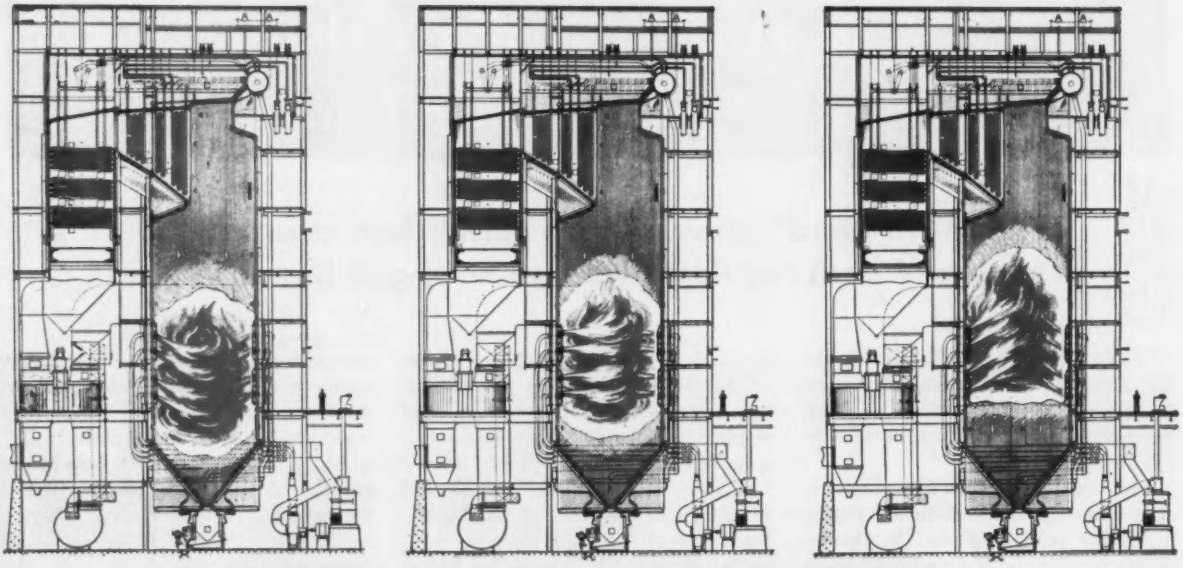
GENERAL ELECTRIC



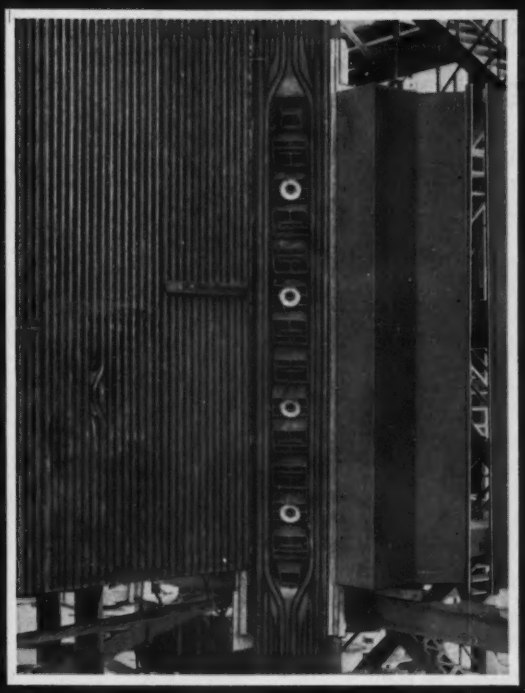
Plan view of tangentially fired furnace shows how action of fuel and air streams sets up extreme turbulence for thorough mixing and complete combustion.

C-E TANGENTIALLY FIRED BOILERS



HOW C-E TILTING TANGENTIAL BURNERS CONTROL SUPERHEAT.

First diagram shows burners tilted downward to reduce furnace outlet temperature. Middle diagram shows normal operating position. Third diagram shows upward tilt to send higher temperature gases to superheater.



Erection view showing shop assembled burner panel being placed in position for welding to wall panels. All four corners of the furnace are similarly equipped.

give more complete combustion... most sensitive steam temperature control

Tangential firing—pioneered by Combustion in 1927—is today the most widely accepted method of firing pulverized coal, gas or oil, separately or together, in large utility boilers. Air and fuel are fed to the furnace in a number of relatively small streams which are directed from each of the four corners of the furnace.

This assures intimate mixing and sets up a strong turbulent motion within the furnace . . . to produce the most complete combustion with minimum carbon loss. The combustion gases fill the furnace for more rapid heat transfer to the waterwalls.

The tilting nozzles of C-E Tangential Burners automatically tilt up or down as steam temperature varies. If steam temperature goes too high, the nozzles tilt downward . . . more furnace wall surface becomes effective . . . gas temperature to superheat surface is lowered . . . steam temperature goes down. Or, if steam temperature drops, the nozzles tilt upward . . . hotter gases go to the superheater . . . steam temperature goes up.

Catalog PC-8 gives full information on tangentially fired C-E boilers, including units with capacities as low as 70,000 lb of steam per hour. Write for your copy today.

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C-E

C-304

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ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

HV Seminar to Be Repeated

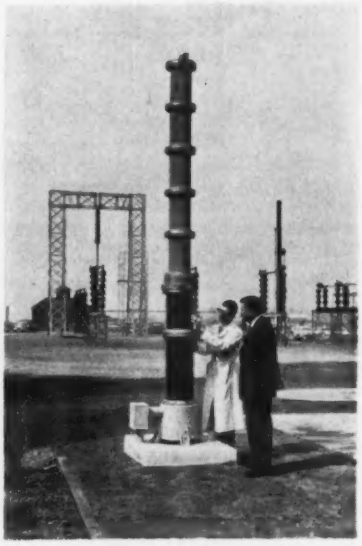
A two-day manufacturer-utility seminar on overvoltages and hi-voltages will soon again be sponsored by the Hi-Voltage Equipment Co, a division of Joslyn Manufacturing & Supply Co. Scheduled for mid-November at the company's development laboratory in Cleveland, reservations are currently being accepted. The seminar will be limited to about 35 engineers.

Agenda for the seminar will follow closely the first and highly successful seminar sponsored by Hi-Voltage Equipment Co this past July. As in the first seminar, Dr J. Zaborszky, Professor of EE at Washington University and consultant to Hi-Voltage, will again team up with J. W. Rittenhouse, the technical director of the company, to present papers and to prompt discussions on analyzation of troubles stemming from specific cases of over-voltages.

Papers presented by the Zaborszky/Rittenhouse team during the first seminar: "Restrikes and Energizing in Resistive Circuits," "Restrikes and Energizing in Inductive and Capacitive Circuits," and "Over-voltages in Coupled Circuits," will be repeated during the forthcoming sessions.

Copies of all seminar papers are available upon request from Hi-Voltage Equipment Co, 4000 E 116 St, Cleveland 5, Ohio. Also, reference materials used during the first seminar are available as follows:

- "Some Fundamental Aspects of Recovery Voltages," Dr J. Zaborszky and J. W. Rittenhouse, June, 1961 . . . from Hi-Voltage Equipment Co
- "Selecting Damping Resistors for Vacuum Switches in Bank-to-Bank Switching," Dr J. Zaborszky, J. W. Rittenhouse and E. L. Luehring, AIEE Transactions, Vol. 78, Part 111A, Power and Apparatus Systems, April 1959, pp 18-23



MODULAR DESIGN of vacuum switches, as demonstrated during seminar, minimizes fragility, moisture condensation and mechanical coupling difficulties

Equipment Ordered for DC Transmission of 600 Mw at 500 Kv

A $17-million order for conversion equipment to transmit 600 Mw at 500 kv direct current—between South Island and North Island in New Zealand—has been obtained by Asea from the New Zealand Electricity Department. Asea is Sweden's leading electrical engineering industry and pioneers in designing and manufacturing such conversion equipment.

Under the terms of the contract, Asea is to deliver equipment as required at Benmore power station (South Island) to convert generated 16 kv 50 cps, to direct current; also conversion equipment for a substation at Haywards near Wellington, where the direct current will be reconverted into 110 kv 50 cps ac for feeding into a grid network.

The total 383 miles of transmission distance includes 335 miles of overhead line on South Island, about 26 miles of submarine cable across Cook Strait, and about 22 miles of overhead line on North Island. Asea's order includes the transformers for this system; however, the submarine cable required will be supplied by British Insulated Callenders Cables Ltd. The power transmission system is scheduled to go into operation in 1965, when the Benmore power station currently under construction is to be completed.

In 1954, the first commercial high-voltage direct-current power transmission system (20 Mw) went into operation between the Swedish mainland and the Island of Gotland in the Baltic. This system operates at 100 kv, over a distance of about 62 miles, with one submarine cable and the sea as a return. The Gotland project was followed in 1958 by an order placed with Asea by the Central Electricity Generating Board and Electricité de France for the conversion equipment required for the power link across the English Channel. This system will involve 160 Mw, transmitted from either shore, at 200-kv direct current.

Asea Gets Other Large Orders

Asea also has been awarded a $3-million contract from Snowy Mountains Hydro-Electric Authority for eight generators for Australia's largest hydro power plant in New South Wales. Each generator will be 102,700 kva, 500 rpm, 15 kv. Asea previously was awarded a contract for eight generators from the authority. Eight Francis turbines to be installed in the new 816-Mw plant are to be built in England and Australia by Bowing & Co, Ltd—subsidiary of Karlstads Mekaniska Werkstad of Sweden. Asea also obtained a $1.4-million order from Royal Irrigation Board, Bangkok, Thailand, for 16 transformers, ranging from 13,000 to 27,000 kva.

(*More News of Manufacturers*, p 94)

Cable's best friend

General Electric silicone rubber insulation protects against heat, overloads, ozone, aging, moisture and radiation

Double Capacity, Overload Protection — When used to insulate cable, silicone rubber gives you up to *twice* the current capacity, *twice* the overload protection as ordinary insulation. The superior electrical properties and wide operating temperature range of silicone rubber are the reasons.

Greater Reliability, Longer Life — G-E silicone rubber insulation has long service life at temperatures from −55°C to 200°C, and it is virtually ageless under severe conditions of heat, ozone, sub-freezing, moisture, and radiation. Trust it to keep working long after ordinary insulation fails.

Possible Cost Savings! What's the price difference? More often than not, *none at all.* In old installations, use it in *existing* conduits. Capacity and protection goes up, costs go down. On new installations, you are buying the extra capacity and overload protection needed in the years ahead. Sound electrical insurance.

Get the full story on cable's best friend: silicone rubber. Write: General Electric Company, Silicone Products Dept., Section FF1060, Waterford, New York.

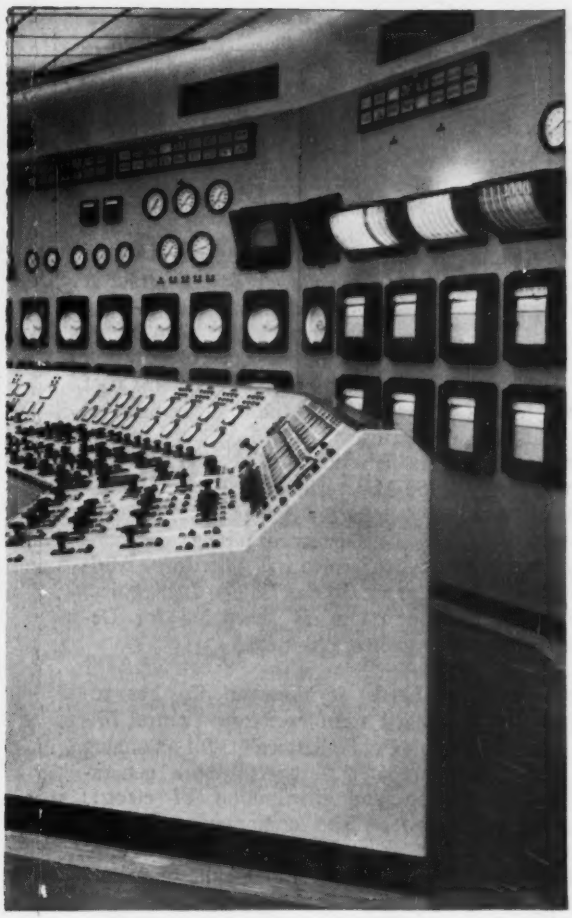
GENERAL ELECTRIC

IT'S BAILEY FOR AMERICA'S

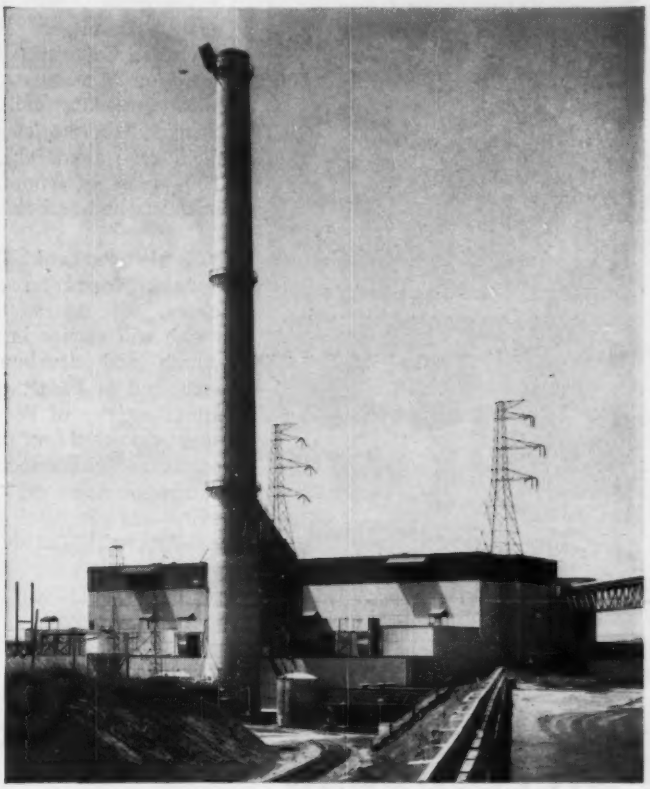
1959 STEAM-ELECTRIC PLANT HEAT RATES FROM FEDERAL POWER COMMISSION REPORT S-143

	Btu/kw-hr	Meters	Combustion Control	Feed Water Control	Superheat Control
1. Dickerson (Potomac Electric Power Co.)	9,007	B	B	B	B
2. Clinch River (Appalachian Power Co.)	9,011	B	—	B	B
3. Kanawha River (Appalachian Power Co.)	9,098	B	B	B	B
4. Silas McMeekin (South Carolina Electric & Gas)	9,130	—	—	—	—
5. Muskingum River (Ohio Power Co.)	9,170	B	B	B	B
6. River Rouge (The Detroit Edison Co.)	9,170	—	—	—	—
7. Clifty Creek (Indiana-Kentucky Electric Corp.)	9,173	B	B	B	B
8. G. G. Allen (Duke Power Co.)	9,174	B	B	B	B
9. Tanners Creek (Indiana & Michigan Electric Co.)	9,176	B	B	B	B
10. Shawville (Pennsylvania Electric Co.)	9,179	B	—	—	B
11. Kammer (Ohio Power Co.)	9,203	B	B	B	B
12. St. Clair (The Detroit Edison Co.)	9,250	B	B	B	B
13. Kyger Creek (Ohio Valley Electric Corp.)	9,284	B	—	B	B
14. Portland (Metropolitan Edison Co.)	9,322	—	—	—	—
15. Oak Creek (Wisconsin Electric Power Co.)	9,336	B	B	B	B
16. Bayshore (Toledo Edison Co.)	9,365	B	B	B	B
17. Milliken (N. Y. State Electric & Gas Corp.)	9,374	B	—	B	—
18. Philip Sporn (Appalachian Power Co.)	9,381	B	B	B	B
19. John Sevier (Tennessee Valley Authority)	9,390	—	—	—	—
20. Mandalay Beach (Southern California Edison Co.)	9,397	B	B	B	B
21. Gallatin (Tennessee Valley Authority)	9,420	—	—	—	—
22. Huntington (Southern California Edison Co.)	9,436	B	B	B	B
23. Colbert (Tennessee Valley Authority)	9,460	B	B	B	B
24. Will County (Commonwealth Edison Co.)	9,460	B	—	B	B
25. Agua Fria (Salt River Project A.I.F. Dist.)	9,473	B	B	B	B
26. Salem Harbor (New England Power Co.)	9,485	B	B	B	B

***per 1959 Heat Rates reported by FPC**



Bailey Controls for combustion, feed water and steam temperatures at the Dickerson Generating Station of Potomac Electric Power Co. The Federal Power Commission reported a 1959 heat rate of 9007 Btu per kw-hr, ranking it as No. 1 plant in efficiency in the United States.



NO. 1* STEAM PLANT

and for 20 out of the next 25 "most efficient" plants, too

Most efficient power plant in 1959, as rated by the Federal Power Commission, was Dickerson Station of Potomac Electric Power Co. And for measuring and controlling functions that helped attain this record, Dickerson relies on Bailey Meters and Controls.

Moreover, *in 21 out of all 26* "most efficient" plants, with heat rates under 9500 Btu per kw-hr, Bailey Meters and Controls are used for some or all functions.

Why? The reasons aren't hard to find. Bailey engineers have worked hand-in-hand with leading power engineers for more than 45 years to advance steam-plant efficiency rates . . . have pioneered the research and development of improved measurement and control techniques that have produced much of today's high reliability of steam-plant operation . . . have simplified and verified instrumentation and control systems to the point where automation can be approached confidently.

And now, working to extend the benefits of automation over the full range of plant operations, Bailey offers systems incorporating advanced techniques for scanning, alarming, logging, computing, digital logic and sequencing . . . all co-ordinated with established analog equipment to provide maximum safety, economy and reliability . . . all compatible with the needs of power management, technical and nontechnical.

Ask your nearby Bailey District Office or Resident Engineer how new Bailey concepts and advanced systems techniques may be applied to your operations.

A-164-2

Instruments, controls, and systems

BAILEY METER COMPANY

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BAILEY METERS

Crapo
GALVANIZED
STEEL STRAND

When in need of guy or messenger strand during an emergency, be sure to contact the nearest distributor of ***Crapo*** Galvanized Strand! Substantial stocks are maintained at strategic distributing points throughout the country ready for immediate delivery. Back of these stocks are our own extensive mill stocks of finished strand, and strand in process. If your jobber does not have all of your requirements, he knows he can depend upon us for immediate shipment of popular sizes and grades by air, truck or rail.

You, in turn, can rely upon ***Crapo*** Galvanized Steel Strand, at all times, to give you the utmost in performance at reasonable cost.

Crapo Galvanized Steel Strand is manufactured in all standard sizes and grades and in three weights of coating: Class A, B and C.

Phone the distributor of *Crapo* Galvanized Steel Strand near you the next time you need strand.

INDIANA
Steel & Wire Co., Inc.
Muncie, Indiana

MANUFACTURERS BRIEFS

• **Anaconda American Brass Co's** new $1.5-million Research and Technical Center was formally dedicated on September 21. Facilities include metallurgical, corrosion and chemical laboratories and pilot plant facilities, staffed initially by about 100—most of whom are research scientists and technicians.

• **Hewlett-Packard Co** has announced formation of **HP Associates,** set up as an affiliation which will engage in solid-state research and development. Headquartered in Palo Alto, Calif., the initial activity of the firm is being directed toward four principal areas: specialized semiconductor devices, electroluminescence, photoconductivity and thermoelectricity. Hewlett-Packard, manufacturer of precision electronic measuring instruments, holds controlling interest in HP Associates.

• **Bodine Electric Co,** Chicago, Ill., has been presented an award by Research Institute of America in recognition of contributions made in furthering business research and in stimulating personal and professional growth of their employees.

• **Hawker Siddeley Industries Ltd** has formed a new division which will handle single-contract design and construction of major engineering projects, including electric power plants and telemetry applications. Hawker Siddeley engineering plans to combine its aviation and heavy engineering techniques to offer process-package deals centrally planned and controlled by a single contractor. The division expects to be up to 90% self-sufficient on most projects, drawing on the group's factories in Britain and overseas for equipment including diesel engines, steam and gas turbines, generators, electric motors, transformers, control and switchgear, electronic, precision, and hydraulic equipment.

• **Electric Service Systems** has acquired from Braham Industries, Inc, a line of pole-top electric switchboxes which formerly were marketed by Bulldog Electric Products Division of I-T-E Circuit Breaker Co. This represents ESS's first active bid for a share of the power distribution equipment market.

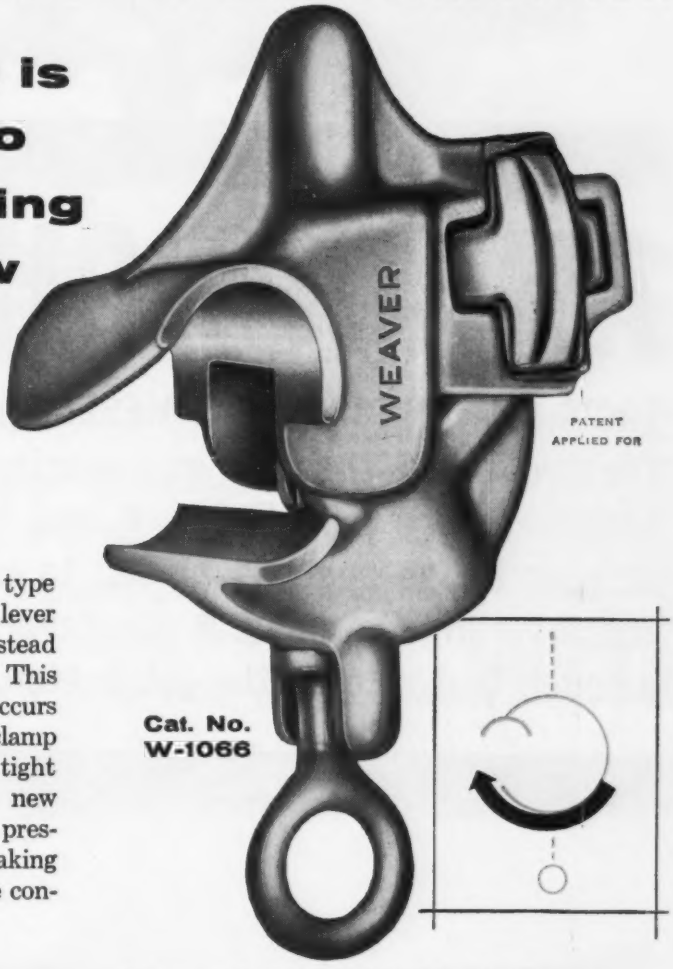
• **Midwest Piping,** Division of Crane Co, has been awarded a contract in excess of $1 million for high-pressure, high-temperature steam piping to be used in the new Ravenswood Plant of Consolidated Edison Co of New York, Inc. Operating at 1,050F and 2,310 psi, the piping will be used in connection with two 363-Mw turbines and two 2,500,-000-lb-per-hr boilers. Completion of the fabricated piping, the contract for which was placed with Midwest by Courter & Co, Inc, project contractors, is scheduled for December of this year.

• **Leeds & Northrup Co** has received a contract from Central Illinois Public Service Co for an analog computer to control both generation and distribution of electric power. The computer, to be installed at Pana Station, will control not only the output of three widely separated steam generators with a combined capacity of 814 Mw, but also the interchange of power between the Central Illinois and interconnected electric companies. In conjunction with previously installed L&N control instruments, the computer will regulate the flow of power to 238,000 customers over a 20,-000-sq-mile area.

• **Reynolds Metals Co** recently shipped reels of aluminum cable, steel-reinforced (ACSR) to Utah Power & Light Co, Salt Lake City in AWG sized 3/0 and 1/0 with lengths of 12,000 and 14,000 ft. Weighing 2,770 and 2,033 lb, respectively, the reels allowed the utility to string longer lines with fewer reel changes. The long lengths were produced and packaged on special 50-in. metal reels; normally, however, says Reynolds Metals, these lengths will be furnished on non-returnable wooden reels in accordance with standard industry practices. Overhead transmission cables in the larger 6/1 sizes, up to 50% longer than previously possible, also may be produced soon.

NEW TYPE HOT LINE CLAMP BY WEAVER ASSURES BETTER, PERMANENT CONNECTION

...more pressure is transmitted to conductor by using an entirely new principle for hot line clamps



Cat. No. W-1066

WEAVER has developed a new type Aluminum Hot Line Clamp using the lever and fulcrum method for tightening instead of the ordinary straight line method. This principle eliminates the friction that occurs in the bolt-and-slider type of hot line clamp when the slider begins to pull up tight against the conductor. With the new WEAVER Hot Line Clamp, greater pressure is transmitted to the conductor making a higher conductivity, lower resistance connection... with less effort!

- Heavy duty spring assures constant contact pressure
- Fewer turns are required to open and close the clamp
- Two large grease recesses keep bolt fully lubricated ... won't drip at high temperatures
- Bell-mouthed and machined wire-bearing surfaces eliminate danger of damage to conductor
- Ears seat firmly in the hot stick and, when open, saddle drops out of the way for safe, easy installation
- Exceptionally long contact surface is the maximum length that can be tightened efficiently with one bolt
- Operates at a lower temperature than the conductor

Order From Your Electrical Wholesaler, or Write, Wire or Phone Collect for Additional Information and Sample

J. A. WEAVER Company

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1962 DODGE HALF-TON PICKUP

ANNOUNCING THE 1

FROM 1/2-TON PICKUP TO DIESEL POWER, Dodge trucks for 1962 feature more than 50 engineering advances to make them tougher, more tight-fisted. ■ And they're on display right now at your Dodge dealer's, priced to compete with every full-size truck rolling the road. ■ Whatever your trucking job, there's a tough Dodge to do the job better, faster, more economically.

1962 DODGE W200 4-WHEEL-DRIVE SWEPTLINE PICKUP

1962 DODGE D500 CHASSIS WITH STAKE BODY

962 DODGE TRUCKS

Advancements include new axles, transmissions, steering gears, diesel engines, and electrical components. ■ Every gasoline-powered model has a 35-amp alternator as standard equipment for faster, surer starts in all weather. ■ See and drive the 1962 Dodge trucks at your dependable Dodge dealer's.

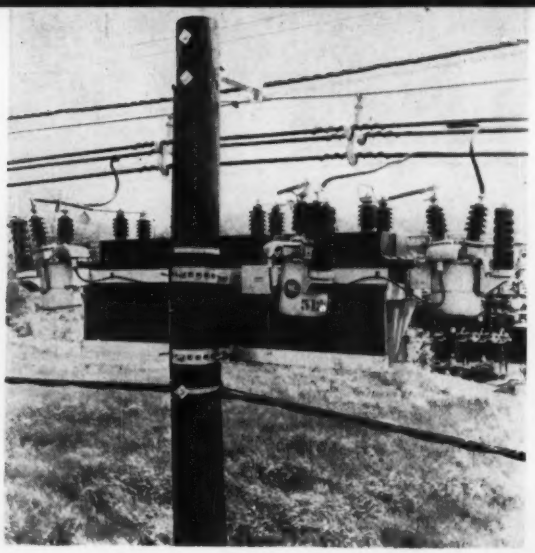
DODGE BUILDS TOUGH TRUCKS

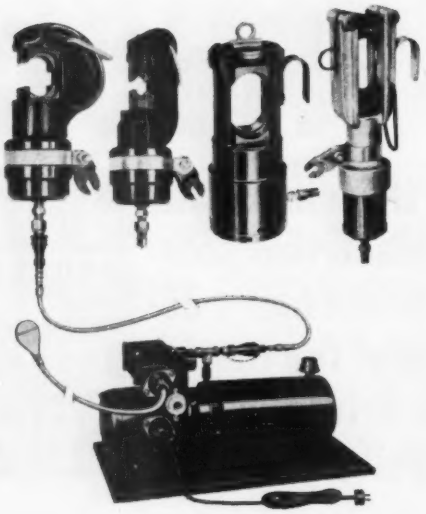
1962 DODGE CT800 GASOLINE-POWERED TANDEM DUMP

New Equipment

Capacitor Protection . . .

. . . is self-contained. Autotrol capacitor banks, 150 to 1,200 kvar, now have built-in lighting arresters and fuse protection, can handle fault currents up to 4,000-amp symmetrical, limited only by 100-amp fuse ratings. Substantial savings are reportedly attributed to the unit's CXP fusing costs. Installation cost is said to be reduced because a separate protective equipment crossarm is not required. For maintenance work, oil switches are tripped out and the bank disconnected through hot-line clamps.
Westinghouse Electric Corp, Pittsburgh 30, Pa.



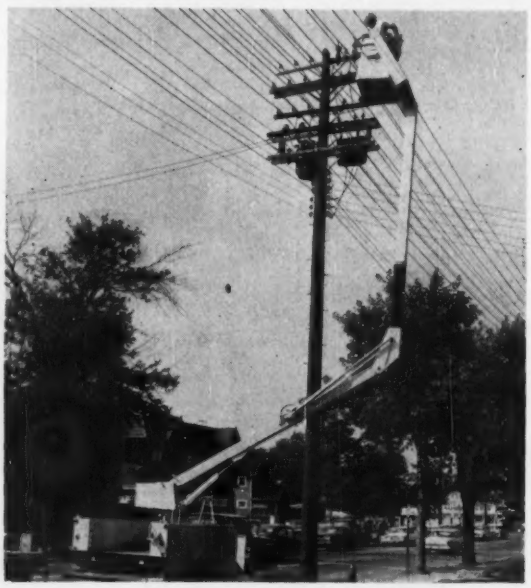


Hydraulic Tool System . . .

. . . includes three interchangeable compression tool heads which can be hotstick-mounted for work on energized conductors or hand-held for cold work. The system contains an hydraulic pump and controls. A power-operated cutter head is available which will cut any type of conductor up to 1½-in. dia in 30 sec or less—or it will cut ground rods, guy wires. The compression tools (PH-1, PH-2 and PH-25) reportedly are capable of completing connections in less than 30% of the time normally required in using hand-operated tools, allowing linemen to work at any angle, at greater distances from the poles and with much greater safety, Squeezon compression fittings, from the smallest to a maximum of 1,192 MCM, can be accommodated. Cutting dies are available for use in the PH-25 for conductor up to 1,500 MCM.
James R. Kearney Corp, St. Louis 10, Mo.

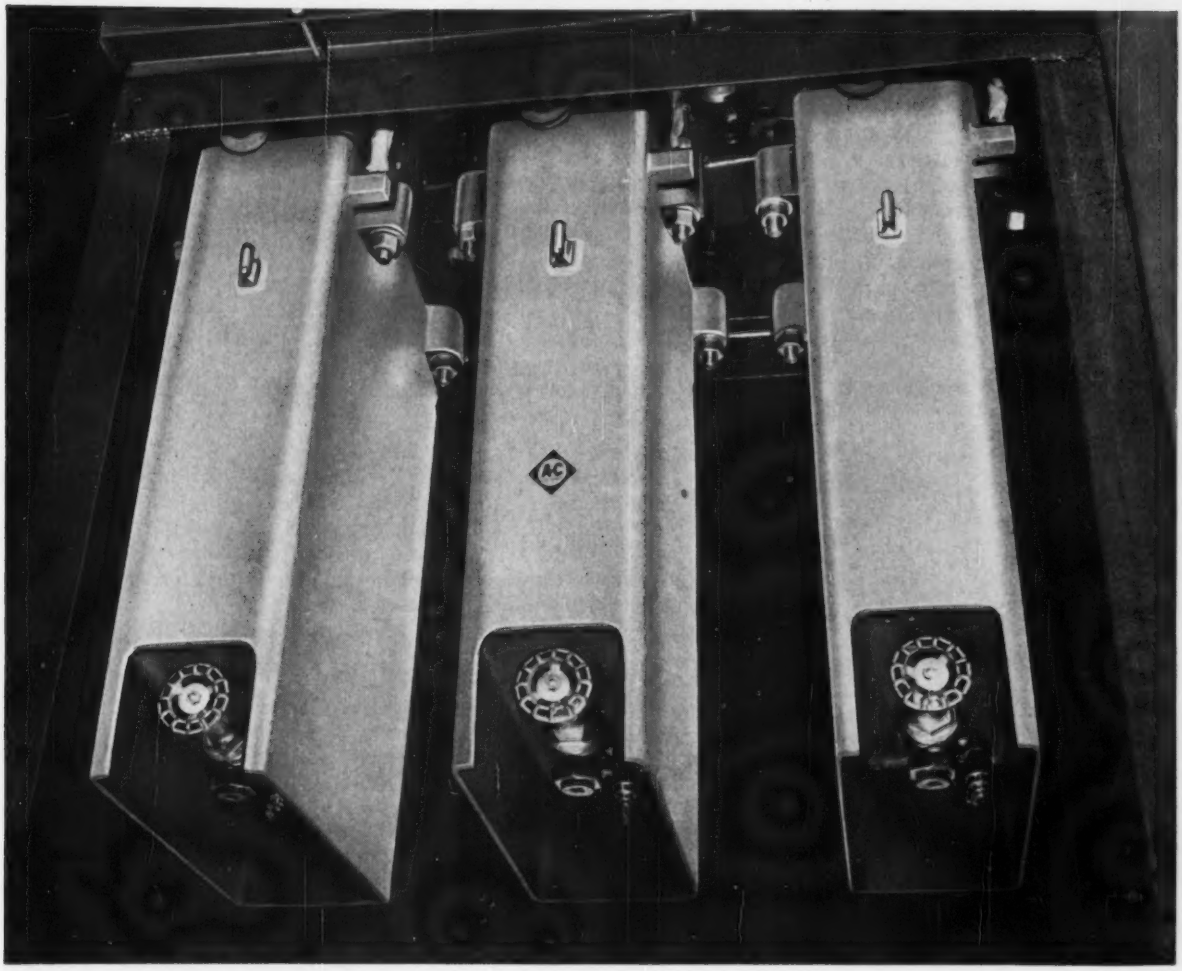
Aerial Elbow . . .

. . . has yoke-suspended bucket. The MV-50 elbow reportedly gives 30% more working range (upper travel: 135 deg; lower arm travel: 85 deg) than "limited action" aerial elbow lifts with other types of bucket suspension. Parallelogram mechanical leveling system automatically keeps the bucket level in all working positions. The elbow reaches up to 50-ft working height, out 30 ft on either side of the body; the bucket will handle 450 lb in all positions. The unit can be fitted with two single buckets or with a winch to convert the elbow into a derrick which can "live boom" from 2,000 to 6,000 lb. The elbow can be mounted on a 102-in. CA, 23,000 # GVW chassis with reinforced frame.
Holan Corp, Cleveland 35, Ohio



(*More New Equipment on page* 100)

ALLIS-CHALMERS



Absolute phase isolation

...available on 14.4 and 23-kv outdoor distribution breakers!

Three-tank construction is a must for transmission circuit breakers to prevent phase-to-phase flashover. A-C gives you this same positive-protection, three-tank construction in 14.4 and 23-kv breakers.

Allis-Chalmers breaker protection extends even further! Each tank is lined with high dielectric insulation. Liners are nonbuckling, nonwarping.

Three-tank design cuts oil contamination and maintenance, since only the faulted phase is affected. And new Type LO cross-blast interrupters (250 and 500 mva) minimize oil contamination even further by reducing interrupting time to *5 cycles* over the *entire* range of interrupting currents (up to 25,000 amps).

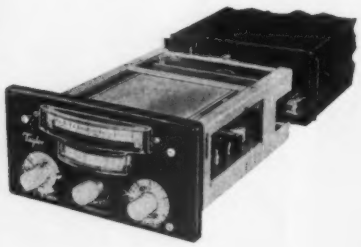
Type OZ breakers are available in 600 and 1200-ampere continuous-current ratings. Your nearby A-C office can give you full details, or request Bulletin 71B9705 from **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1423

Two rugged, cross-blast interrupters per phase reduce arcing time to less than 5 cycles — sharply cut oil contamination.

Aerial Ladder/Lift . . .

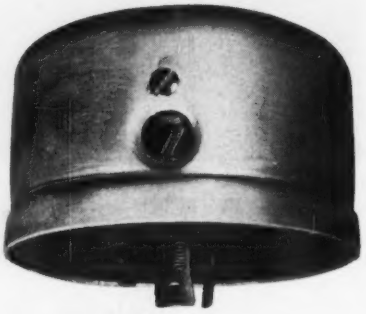
. . . raise workmen about 40 ft and 25 ft, respectively. The aerial ladder, built onto a Volkswagen pickup truck, swivels through a complete circle to aim ladder in any direction. Truck is held steady by rear-mounting stabilizing jacks. Ladder turret and other special equipment weigh about 1,000 lb, giving vehicle an 840-lb payload rating. The Volkswagen hydraulic lift has basket-located controls for raising, lowering and swinging it through the 180-deg operating arc, so that truck/lift is a one-man operation. Stabilizer jacks located on each side of the vehicle are activated from the lift's hydraulic pump, operated off truck's engine. Carrying capacity of the basket is 320 lb.
Volkswagen of America, Englewood Cliffs, N. J.

Control Stations . . .

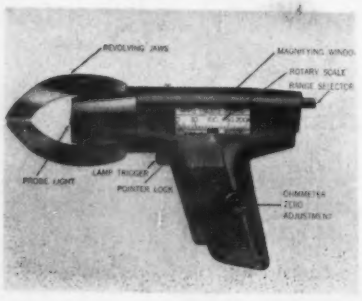


. . . electronic, for 24-v and 1-v systems, feature full-scale process indication, complete manual power supply and a compact design for panel mounting. The 701K series provides a large 3-in. process meter and a 2-in. output meter centered on the front panel for easy viewing. Calibration of both meters is based on 1 to 5 ma dc. A multi-position switch permits bumpless transfer from automatic to manual control modes, also balancing of the controller's operational amplifier. Chassis may be partially removed from its case while still on control for inspection or maintenance. The 701N series, also new, is a non-indicating version which does not have the process indication meter.
Taylor Instrument Cos, Rochester 1, N. Y.

Street-Light Control . . .

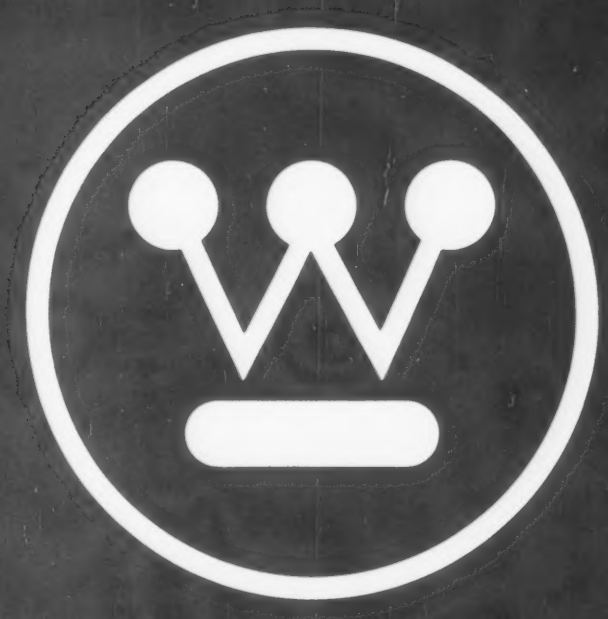


. . . permits field selection of foot-candle operating level without removal from receptacle—even when control is in operation. Although the unit is factory calibrated and set for ½ foot-candle, resetting in the field may be quickly achieved. A screw, accessible from the front of the Dialatrol case, may be adjusted while referring to the foot-candle number (1, 2, or 3), visible through the Plexiglas window. Varistor surge-protection for the hermetically-sealed photoconductive cell is provided. Capacitors and rectifiers are eliminated from the circuit. Unit has Joslyn Mfg & Supply Co lighting arrester, a tough aluminum case.
Lightguard Electronic Manufacturing Co, Inc, Houston 3, Tex.



Test Meter . . .

. . . lightweight pistol-type, is said virtually to eliminate difficulties in measuring current, voltages, resistance and testing circuits in inaccessible areas. Revolving jaws at the muzzle-end of the Pistolmeter permit insertion into cramped locations at any convenient angle. The trigger-operated probe light at the meter's end insures safe handling. Meter has a color-coded rotary scale with four current ranges: 0 to 15/60/-200/600 amp; two voltage ranges: 0 to 150/600 v; and two ohmmeter ranges: 0 to 500/5,000 ohms. Locking device permits reading the Pistolmeter, after it has been removed from the tested conductor. Tester has a rechargeable battery, comes with test leads, battery charger and holster.
Federal Pacific Electric Co, Newark, N. J.



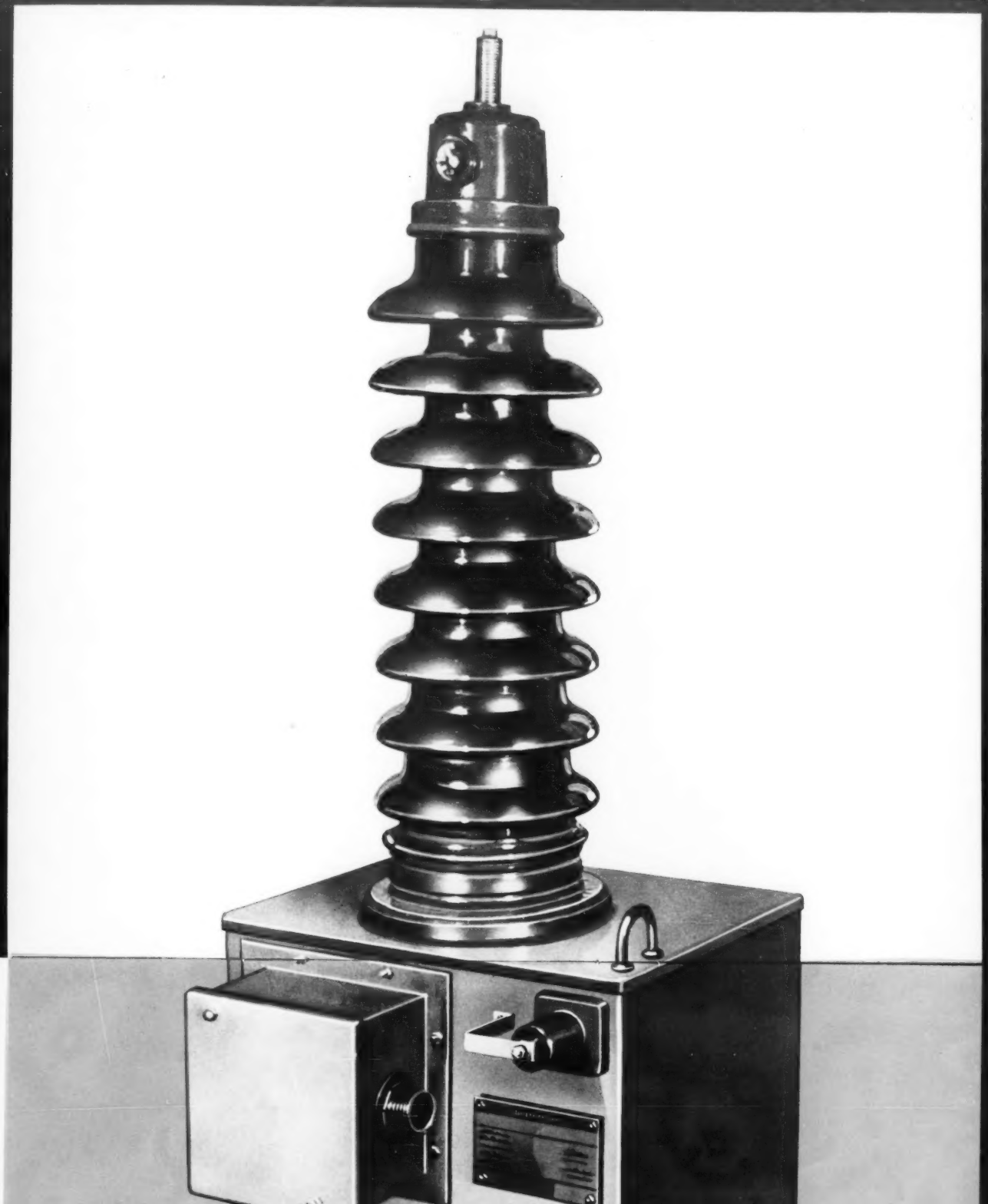
FROM WESTINGHOUSE... LEADER IN HIGH VOLTAGE INSTRUMENT TRANSFORMERS

COMPLETELY NEW POTENTIAL TRANSFORMER AT NEW LOW PRICES

NEW—APT FOR LINE-TO-GROUND SERVICE • 25 THROUGH 69 KV
lowest cost of any equivalent design

NEW—APT FOR LINE-TO-LINE SERVICE • 25 THROUGH 69 KV
lowest cost of any equivalent design

NOW... APT ADVANTAGES IN A COMPLETE LINE OF POTENTIAL TRANSFORMERS 25 KV THROUGH 345 KV



TYPE APT POTENTIAL TRANSFORMER

Outdoor • Oil Filled • Single Bushing, with Graded Insulation • ASA Metering Accuracy: 0.3 Class for W, X, Y, and Z Burdens

25 KV 34.5 KV 46 KV 69 KV

COMPARE

NEW WESTINGHOUSE APT's ARE SMALLER ...LIGHTER THAN OTHER MAKES

(Single Bushing, 69 kv)

Type	Weight: Lbs.	Height: Inches	Thermal Rating: va	Oil: Gallons
(W) APT	570	58½	6000	13½
Mfr. "B"	950	71	5500	29
Mfr. "C"	950	63¾	6000	30
Mfr. "D"	1050	63	6000	23

NEW—APT FOR LINE-TO-GROUND SERVICE • 25 THROUGH 69 KV
lowest cost of any equivalent design

NEW—APT FOR LINE-TO-LINE SERVICE • 25 THROUGH 69 KV
lowest cost of any equivalent design

NOW... APT ADVANTAGES IN A COMPLETE LINE OF POTENTIAL TRANSFORMERS 25 KV THROUGH 345 KV

LOOK AT THE SAVINGS IN SIZE AND WEIGHT

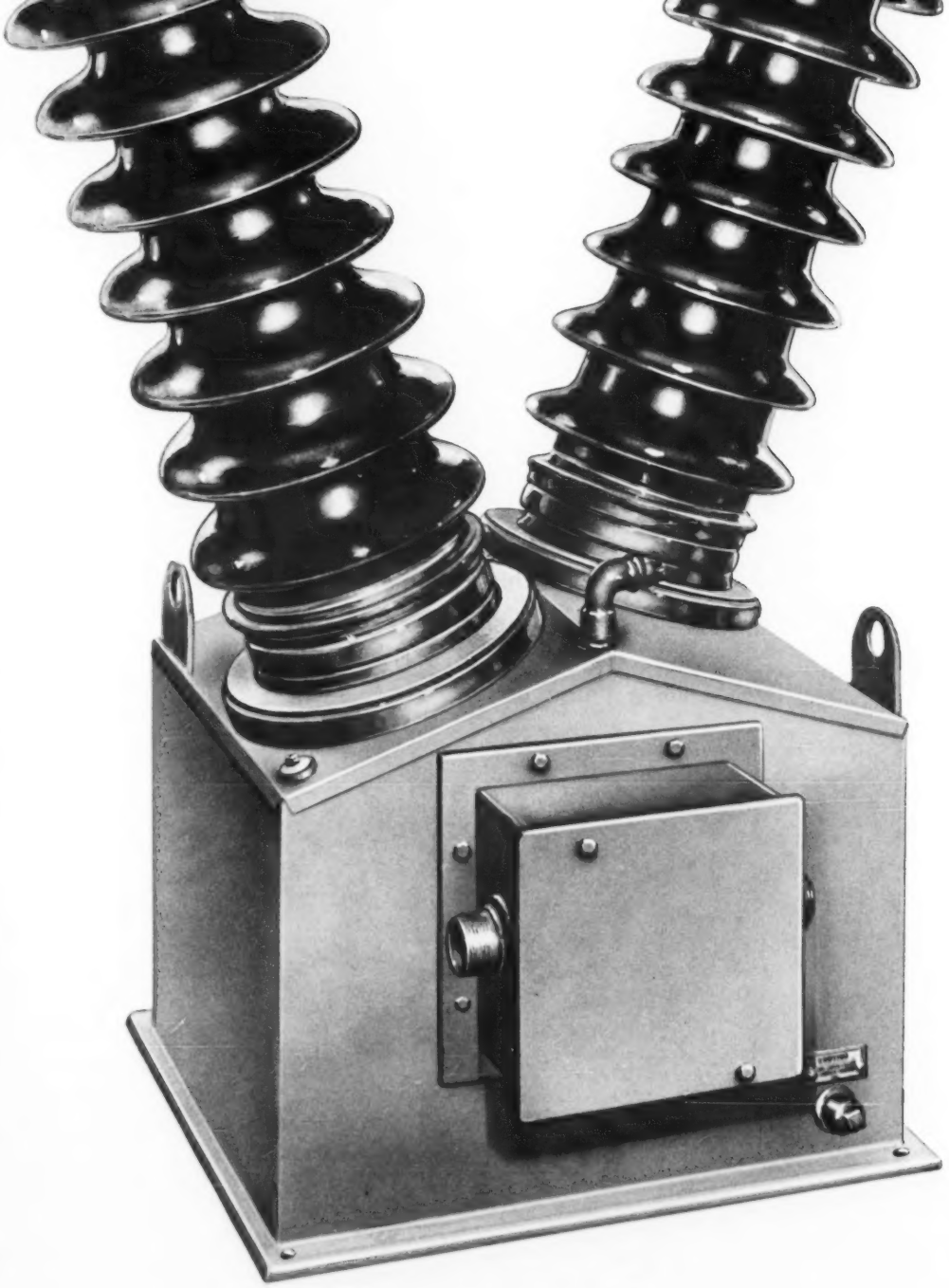
(Two Bushings, 69 kv)

Type	Weight: Lbs.	Height: Inches	Thermal Rating: va	Oil: Gallons
(W) APT	750	56	7000	14½
Mfr. "B"	1040	60	6500	33½
Mfr. "C"	1160	61	6000	37
Mfr. "D"	1150	61	6000	30

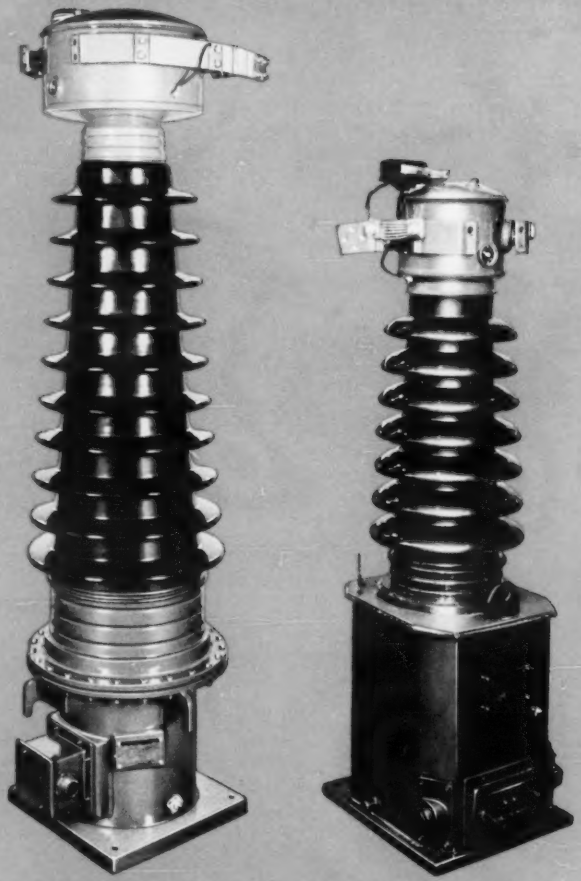
TYPE APT POTENTIAL TRANSFORMER

Outdoor • Oil Filled • Two Bushings, with Full Insulation • ASA Metering Accuracy: 0.3 Class for W, X, Y, and Z Burdens

25 KV 34.5 KV 56 KV 69 KV



NEW—APT FOR LINE-TO-LINE
SERVICE · 25 THROUGH 69 KV
lowest cost of any equivalent design



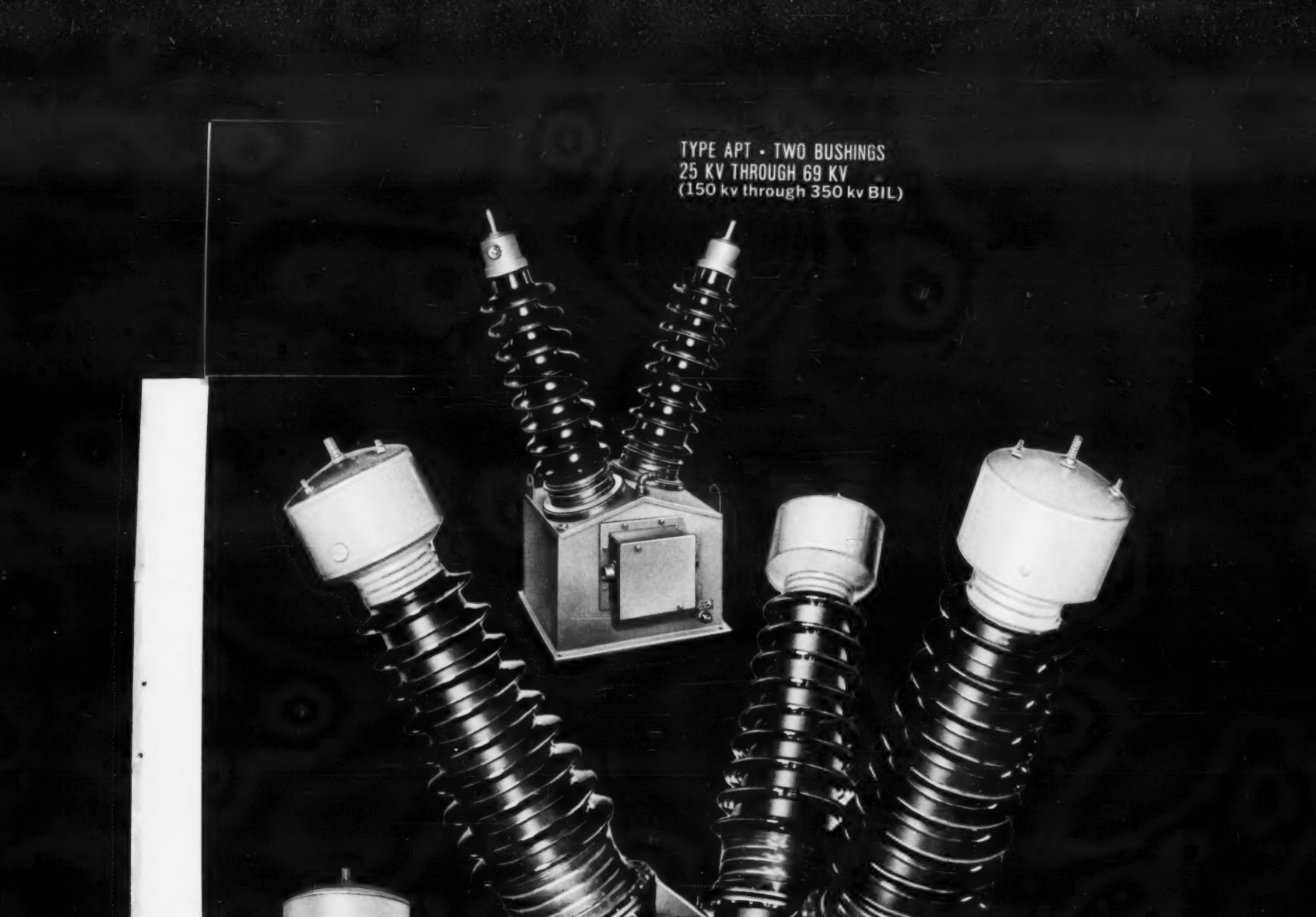
TYPE OCT CURRENT TRANSFORMER

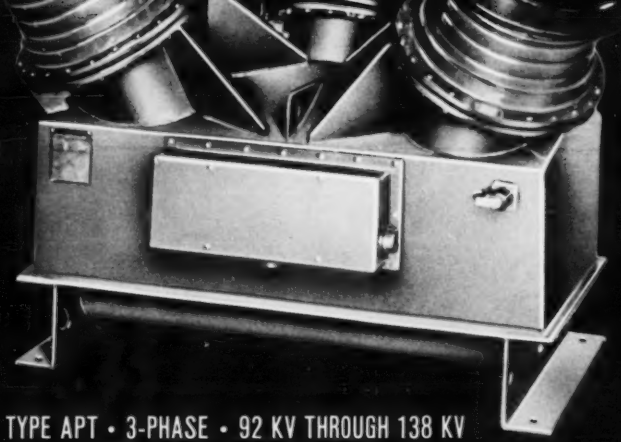
Outdoor • Oil Filled • 25 kv through 69 kv (150-350 kv BIL) • Primary Amperes: 10 x 20 through 1500 x 3000 • 25 to 60 cycles

TYPE ACT CURRENT TRANSFORMER

Outdoor • Oil Filled • 92 kv through 460 kv (450-1300 kv BIL) • Primary Amperes: 10 x 20 through 1500 x 3000 • 25 to 60 cycles

TYPE APT • TWO BUSHINGS
25 KV THROUGH 69 KV
(150 kv through 350 kv BIL)

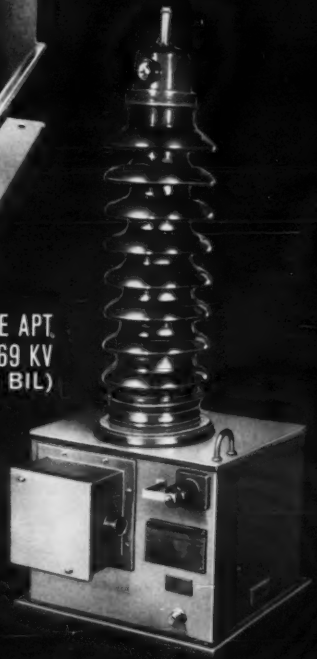

TYPE APT • TWO BUSHINGS
25 KV THROUGH 69 KV
(150 kv through 350 kv BIL)



TYPE APT • 3-PHASE • 92 KV THROUGH 138 KV
(450, 550 and 650 kv BIL)

TYPE APT
92 KV THROUGH 345 KV
(450 kv through 1300 kv BIL)

TYPE APT
25 KV THROUGH 69 KV
(150 kv through 350 kv BIL)



THIS IS APT

a dependable family of high-voltage potential transformers for all metering and relaying applications. Only the Westinghouse APT line offers all these years-ahead features:

• Smallest size, rating for rating • Lightest weight, size for size • Exclusive "solid insulation" design • Single core-and-coil construction—built like a power transformer • Leakproof, all-welded assembly—only one gasket joint, rolled-on hardware

NOW... APT ADVANTAGES IN A COMPLETE LINE OF POTENTIAL TRANSFORMERS 25 KV THROUGH 345 KV

TYPE FMU METERING UNIT (FORM-FIT)

25 KV (150 KV BIL) **34.5 KV** (200 KV BIL)

46 KV (250 KV BIL) **69 KV** (350 KV BIL)

Other metering units available in voltages 5 kv through 161 kv.

WESTINGHOUSE METERING UNITS

Westinghouse Metering Units combine current and potential elements in a single unit for high voltage metering, relaying and control.

-70977

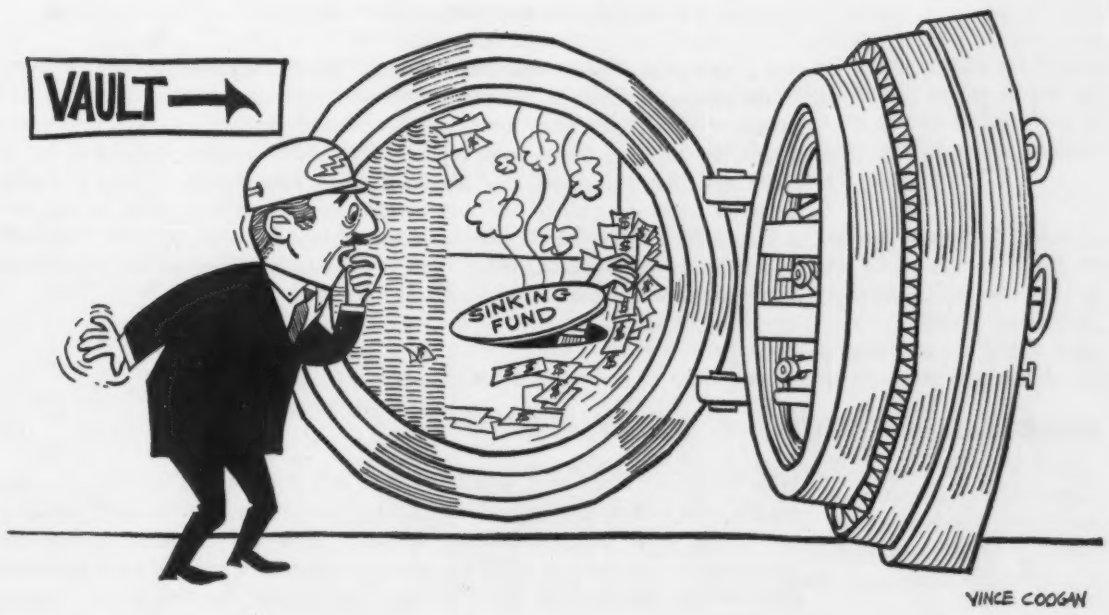
Printed in U.S.A.

YOU CAN BE SURE...IF IT'S **Westinghouse**

Electrical World

OCTOBER 2, 1961

Management Newsletter



Sinking Funds Are Expensive

Sinking funds are a cost to utilities issuing bonds. And like any other cost they should, if at all possible, be reduced. But, says Willard F. Stanley, former financial executive with an electric utility, and presently financial consultant, utilities tend to accept this expense as something beyond their control. And when it comes to sinking and improvement funds, they sometimes don't even realize that the cost is there.

Utility bonds, as well as those of other industries, are usually accompanied by a sinking fund provision. The idea of such a provision is that the utility agrees to buy back some of the bonds issued before the date of maturity in order to reduce the amount of debt outstanding. Traditionally, the utility purchases 1% of the total amount of the original issue each year. Since tradition has also dictated that the maturity date of utility bonds will be 30 years from the date of issue, the effective weighted average maturity of the bonds is reduced from 30 years to 25.5 years. Such a provision naturally reduces the amount of risk attached to the purchase of the bonds, and will be taken into consideration by the investment bankers when bidding on the issue.

Originally, sinking funds were cash sinking funds, and this is still the case for many industries. While there are many variations of the cash sinking fund, the essential principal is that the corporation is required to put up annually a sum of money to buy or redeem some of the bonds of the issue to which the sinking

fund is attached. These bonds are then cancelled. Usually, in utility sinking funds, this is done under the administration of a trustee.

But the cash sinking fund is now the exception for electric utility offerings. Today, the utility is usually given the option of either purchasing bonds of the issue being protected, or, pledging property of a value equivalent to 1⅔ times the amount of money that would have been used to purchase the bonds. This pledged property then stands as additional security for the issue being protected.

The advantages of such an arrangement are obvious. As expansion continues, existing bonds do not have to be paid off. And, at the same time, the amount of risk attached to holding the bonds is reduced just as it is with a cash sinking fund.

But at this point, Stanley voices his warning. The sinking fund, he says, is a cost to the company. There is sometimes a tendency to view sinking funds not as a necessary evil—which from the company's standpoint, they are—but rather as a means for reducing the over-all indebtedness which is often considered by the company to be a desirable practice. In addition, this element of cost is further obscured when the sinking and improvement fund is used in place of the cash sinking fund. Utilities which recognize the cash sinking fund as a cost frequently forget that for an expanding utility there is no essential difference between sinking and improvement funds and cash sinking funds.

REPLACING DEBT RETIRED IS COSTLY PROCESS

What is the cost involved in a cash sinking fund? Basically, its the cost of replacing the debt retired with higher cost money. Suppose a utility is, under terms of the sinking fund, retiring $200,000 annually. How will the utility replace this amount after it is spent to purchase bonds? Obviously, it will not issue unsecured debentures or first mortgage bonds on unpledged property for such a small amount, so the only method is by common stock money, either in the form of retained earnings or by sale of additional shares.

This replacement process is costly. Even with the exceptional high price-earnings ratios now prevailing for electric utility common stocks (something over 20 to 1) a 5% cost of common stock funds before selling expense is indicated. If we assume a selling expense of 5%, we have a total cost of equity money somewhere in the neighborhood of 5.25%.

This cost is quite a bit higher than the cost of the first mortgage money which is being retired by the sinking fund arrangement. Stanley estimates that after deducting the tax saving involved in the interest expense of first mortgage bonds, and making a reasonable allowance for selling expense, the cost of the first mortgage bonds figures out to something like 2.25%. This means that the debt which is being retired costs 3% less each year than the equity money which is replacing it. This difference is an annual loss to the company.

Let's assume a $10-million first mortgage bond issue of an electric utility, carrying a 1% annual sinking fund. Over the 30-year life of the bonds, $3 million of bonds would be retired under the sinking fund, and would thus be shifted into higher costing common stock. If we use the cost differential of 3% a year, and use an average life of 15 years, the additional cost to the company involved in the sinking fund is about $1,350,000.

If utilities fully recognized this cost, they would take steps to reduce it, Stanley believes. But the cost is not as readily apparent as some of the other costs of doing business, and the tradition of a 1% sinking fund is accepted as normal.

Under the more modern arrangement of the sinking and improvement fund, this cost is even less readily appreciated. This is because utilities don't have to put up the cash to buy back bonds. Instead, they are merely pledging new property as added security against old issues. If mortgage bonds can be issued in amounts representing 60% of the property pledged, then the utility pledges property valued at 167% of the amount which would have been used to purchase bonds under a cash sinking fund arrangement. Since none of the old debt is being retired, it may appear that the cost of money to the utility is not being raised. But Stanley insists that this is an illusion.

If the electric utility industry were static, the sinking and improvement fund would result in a real cash saving to the company. But, says Stanley, this is an industry which perennially expands at a considerable rate. And, it is usually necessary to finance these additions by issuing bonds. In this case, the company does not benefit from the improvement fund provision since its savings in not having to put up sinking fund cash is offset by the reduction in the amount of new bonds which it may issue and sell. This is because some of the property against which it might have issued bonds is now frozen as support of a previous issue.

Since the amount of property against which the utility may issue new bonds is reduced, a smaller amount of the utility's future capital needs can be raised by issuing bonds. This means that a greater amount of the funds needed will have to be in equity money. So, once again, the difference in cost between bonds and common stock money comes into the picture. And once again, the utility finds that the sinking fund involves a real cost, even though the cost may not be so readily apparent.

The sole advantage of the sinking and improvement fund, Stanley says, is that it saves the company the cost of issuing the additional bonds which it would otherwise issue against the property additions certified for the improvement fund. This saving to the company, though not substantial, is sufficient to make the improvement fund feature more desirable from the company's standpoint than the cash sinking fund.

But it is not sufficient to offset the difference between the cost of the first mortgage bonds being retired and the equity capital which will replace it. And this cost is directly proportional to the rate of the sinking fund.

Under present conditions, it probably would be impossible to issue first mortgage bonds without sinking funds. But it may well be possible, Stanley feels, to issue these bonds with sinking funds below 1% a year. This could constitute a sizable saving for the utility.

Those companies whose bonds must be offered at competitive bidding probably would find it difficult to push down the sinking fund because they would no doubt feel it necessary to offer to the bidders the conventional type of security in order to assure getting the highest possible bids. But where electric utilities are free to sell their bonds by a negotiated sale to the public through underwriters, or by private sale to insurance companies or other institutions, there is the possibility of negotiating a set-up with lower sinking fund payments.

If the sinking fund on a $10-million 30-year first mortgage bond issue were lowered from 1% annually to ½%, the saving would amount to about $675,000, or $22,500 a year. This figure assumes a 3% money cost differential between common stock and bonds applied to the $1.5 million of bonds affected by the reduction in the sinking fund. On a pre-tax basis, this saving would be equivalent to a reduction in yield of something like 0.225%, Stanley calculates, providing the yield at which the issue was sold were the same as though the sinking fund were 1% a year.

But this assumption, that the issue with a ½% sinking fund could be sold at the same yield as an issue with a 1% sinking fund, is by no means certain. Probably, the reduction of the sinking fund would be considered as adding new risk to the bonds. And the utility could expect to see some increase in the interest it would have to pay in view of this increased risk.

There's no rule of thumb as to the relationship between the rate of the sinking fund and the yield which a particular issue will carry. And investment bankers won't even venture a guess. The institutions and other ultimate purchasers of the bonds will, of course, value each company differently. And they will have different ideas about the importance of the sinking fund for any given company.

In some cases, the increased yield might more than offset the advantages gained by the reduction in the sinking fund. For other companies, the reduction in the sinking fund might have little effect on the yield.

UTILITIES SHOULD FIGURE NEW ISSUES FROM BOTH ANGLES

For the present, Stanley recommends that utilities figure a new issue from both angles. Financial management of utilities is cognizant of the going money cost for first mortgage bonds of the rating which applies to their company's obligations. They can use this normal current yield to check the yield proposed by the underwriters or institutions on the proposed bonds with lower sinking funds. This will give them some conclusion as to whether the lower sinking fund represents a net asset or a liability.

But normal current yield isn't really an accurate yardstick for an individual company. For this reason, it would be wise for utilities to seek the advice of underwriters and pin down the two alternatives for their company. They could get an estimate of the yield with the conventional 1% sinking fund, and with a proposed ½% sinking fund. A comparison of these two situations would show with greater accuracy which approach was best for the utility in question.

In many cases it may prove unfeasible to make any notable savings through the use of lower sinking funds, Stanley admits, but the possibility of such savings seems sufficient to warrant attention from the utilities.

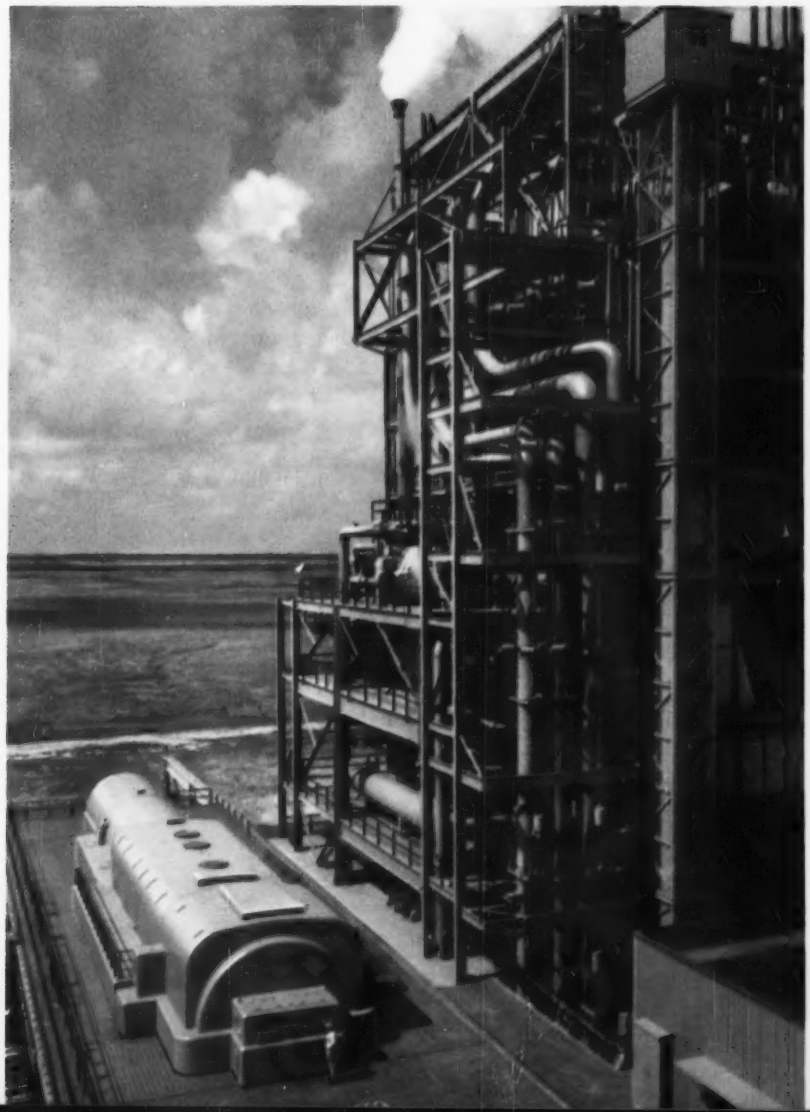
But this is only a short range view to the problem. The larger question is, do utilities have to accept a situation in which a sinking fund reduction means an increase in yield? Such a situation implies that the sinking fund reduces the risk to the investor. But does the sinking fund really make an important contribution to reducing risk?

Stanley hints that it doesn't. The sinking fund, he feels, when applied to electric utilities, is more a product of tradition than a necessary element of protection. Utilities should attempt to hammer home this notion to the financial community. If they were successful, then sinking funds might be reduced without any proportionate increase in yields. And consequently, a very real and surprisingly large cost to the utilities would be reduced.

It may, however, take a long time to reverse such a well-established tradition. In the meantime, two things are important. Utilities must recognize that sinking funds are costly. And then, they must take every possible step to reduce them. One step, which Stanley has suggested, is that the utilities weigh each issue both with the conventional sinking fund rate of 1%, and with a reduced sinking fund rate. If this were done, Stanley feels, some utilities might be able to cut sinking fund costs, not some time in the future, but right now.

NEW

INSTALLATION TECHNIQUES MAKE ALL OTHERS OBSOLETE



ALLIS-CHALMERS

A-1492

Pre-installed piping systems and precision optical tooling cut man-hour expenditures as much as 34 percent

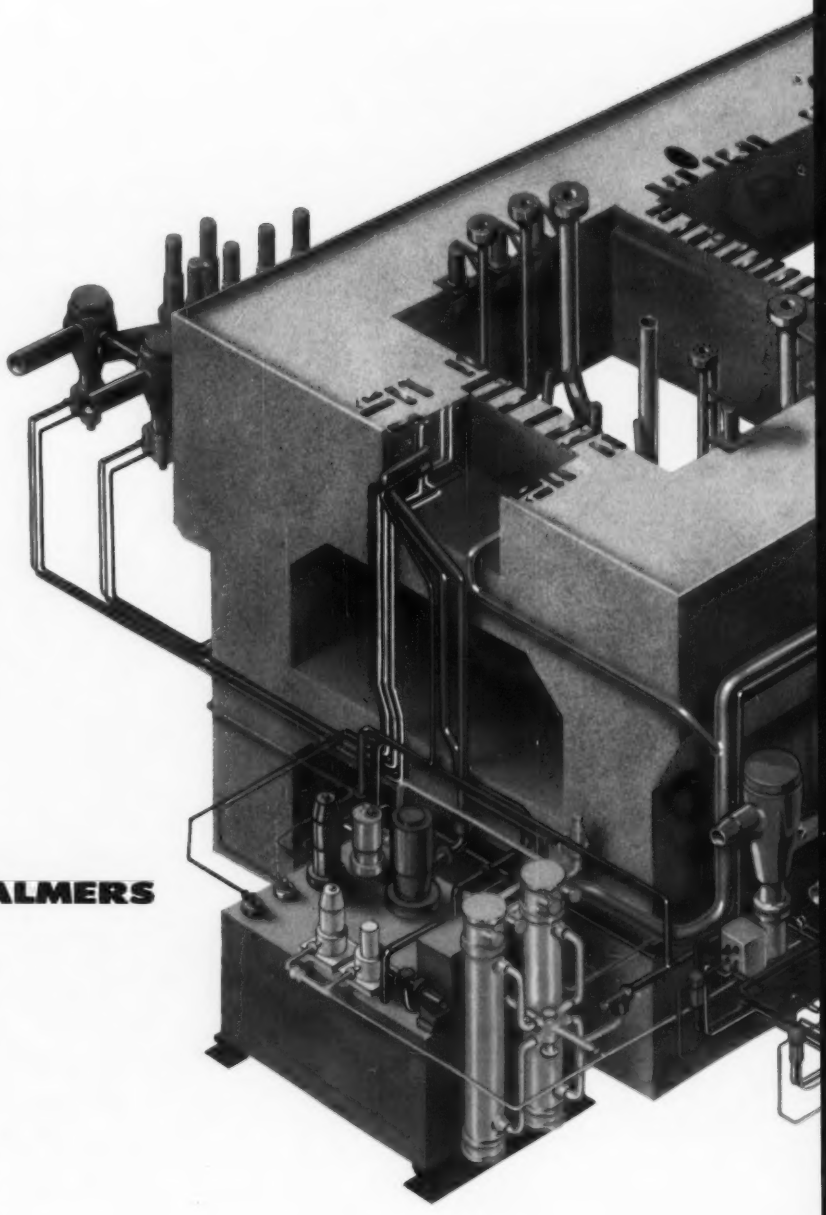
Exclusive A-C tools and techniques reduce turbine-generator installation costs — permit faster, ultra-accurate unit assembly — establish new power industry standards.

For example, a 220-mw tandem triple-flow unit (see bar chart) was recently installed in 25,000 man-hours with new A-C techniques — against 38,000 man-hours required with other methods. And this machine was placed on the line without a shutdown between first steam admission and attainment of maximum load — dramatic proof of the effectiveness of the advanced Allis-Chalmers methods. Equivalent results, unmatched in the industry, are being recorded with other large A-C units!

Factory-field coordination, based on modern turbine-generator assembly and testing facilities, translates components from test pit to foundation with absolute precision and man-hour reduction.

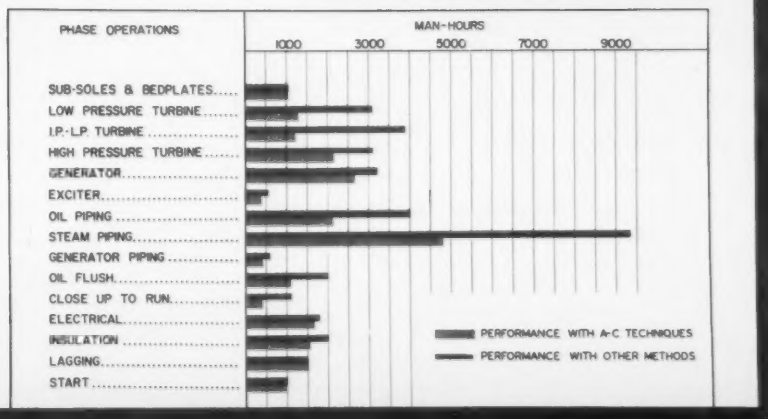
Advances such as these stem from Allis-Chalmers vast experience and forward-thinking engineering. They help electric utilities meet the economic and scientific challenges of tomorrow.

ALLIS-CHALMERS



Pre-Installation of All Below-Floor Pipe and Equipment is completed prior to placing of main unit components on foundation plates. This technique saves thousands of man-hours — assures highest degree of cleanliness and quality for piping and closure welds. Complete oil tank assembly and piping, steam chest, reheat valves and piping, generator coolant and scavenging piping systems are installed with better control . . . also, less interference because fewer men are present; the work area more accessible.

At the Pre-Installation Conference, A-C engineers meet with utility, consulting and contractor personnel to discuss the installation program and plan man-hour estimates. Installation procedures (below in bar-chart) are reviewed to determine necessary manpower, tools and facilities required at various stages of progress.



PROCEDURES COORDINATED BY UNIFIED SUPERVISION

minimize installation time . . . assure ultra-accuracy . . . simultaneously!

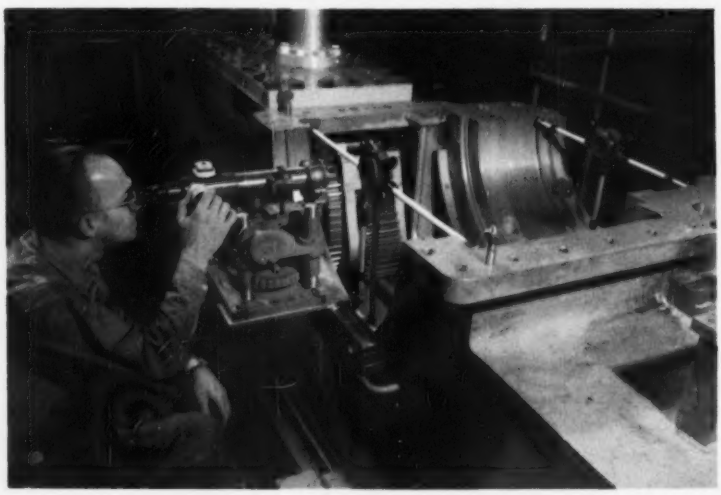
Installation Responsibility Under One Superintendent unifies job supervision — uniquely covers existing A-C equipment at the power station as well as new turbine-generator and additional A-C products. Central responsibility assures close control of installation procedures — permits prompt job-site decisions.

Special Centerline Telescope permits quick alignment of major turbine components. During manufacture this precision instrument determines final relative position for each pedestal bearing bore. At the job site, the telescope re-establishes this centerline for accurate turbine assembly with all clearances as determined at the factory. Field measurement of internal clearances is eliminated and installation of components, including those shipped with spindles in position, is accomplished faster and more accurately.

☆ ☆ ☆

For Bulletin 0389997, *which gives you further information about Allis-Chalmers advanced installation techniques, ask your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.*

With Precision Optical Leveling Equipment, field installation of Allis-Chalmers turbine-generator units is little more than a reassembly operation. Savings to you . . . over 8,000 man-hours for a tandem triple-flow machine; similar reductions for other types and ratings. This special tooling permits simultaneous establishment of horizontal reference planes on the test pit (top) and on the foundation (bottom). All factory-recorded clearance and reference data plus assembly shim packs are translated from level plane to level plane. *Result: precise unit alignment and assembly with no time-consuming "cut and try" operations or delaying field adjustments.*



ALLIS-CHALMERS PACING POWER PROGRESS

Pulley Appointed President of Gulf Power Co

PULLEY

Robert L. Pulley has succeeded Lansing T. Smith Jr as president of Gulf Power Co. Smith retired after six years in office.

Pulley began his utility career with Alabama Power Co. He joined Gulf Power in 1925 and became chief engineer ten years later. He was named operating manager in 1947, a vice president in 1951 and general manager last year.

As Smith was preparing to retire, Gulf Power's board named its newest and, ultimately, largest steam electric generating station after him. The plant, called "Lansing Smith Steam Plant," is being built on St. Andrews Bay at Panama City, Fla.

GE Promotes Ellis, Gough to Regional Vice Presidencies

Charles J. Ellis and Harry P. Gough have been elected regional vice presidents of General Electric Co. Ellis succeeds Carter L. Redd in the southeast region, and Gough replaces Clarence C. Walker in the western region. Redd and Walker, until they retire in January 1962 and November 1961, respectively, will act as consultants to their successors.

Ellis was most recently district manager of electric utility sales for GE in Tampa, Fla. He will have headquarters in Atlanta, Ga.

Gough has been general manager for sales and distribution of major appliances and TV at GE's northern California district headquarters. His new headquarters will be in San Francisco.

ELLIS GOUGH

Humphreys Gets Promotion At Pacific Power & Light

Philip G. Humphreys has been named superintendent of power production for Pacific Power & Light Co, succeeding L. A. Morphey who will retire.

HUMPHREYS

Humphreys has served as power production superintendent for California Oregon Power Co division of PP&L since June.

Wisconsin Electric Power Names McNeer EE Manager

Charles S. McNeer is the new manager of electrical engineering for Wisconsin Electric Power Co, succeeding Willard S. Wilder who retired after 42 years with the utility.

McNeer joined Wisconsin Electric Power in 1950. He was appointed assistant superintendent of electrical operations in 1958. Two years later he became assistant manager of electrical engineering, the position he held until his recent promotion.

Phelps Dodge Picks Webb As Utility Sales Manager

Phelps Dodge Copper Products Corp has appointed Robert A. Webb as manager of utility sales. He will report to Carl D. Dimity, assistant vice president.

Webb joined the company in 1946 as an engineer in the wire and cable division's production department. In 1947 he was named field installation engineer, supervising high-voltage cable systems. Webb transferred to utility sales in 1952 and became a power cable sales engineer.

Bartlett Named President Of Bartlett Tree Experts

Robert A. Bartlett has been elected president of Bartlett Tree Experts, Stamford, Conn. He succeeded Orville W. Spicer who retired after 46 years with the company, the last 24 as president.

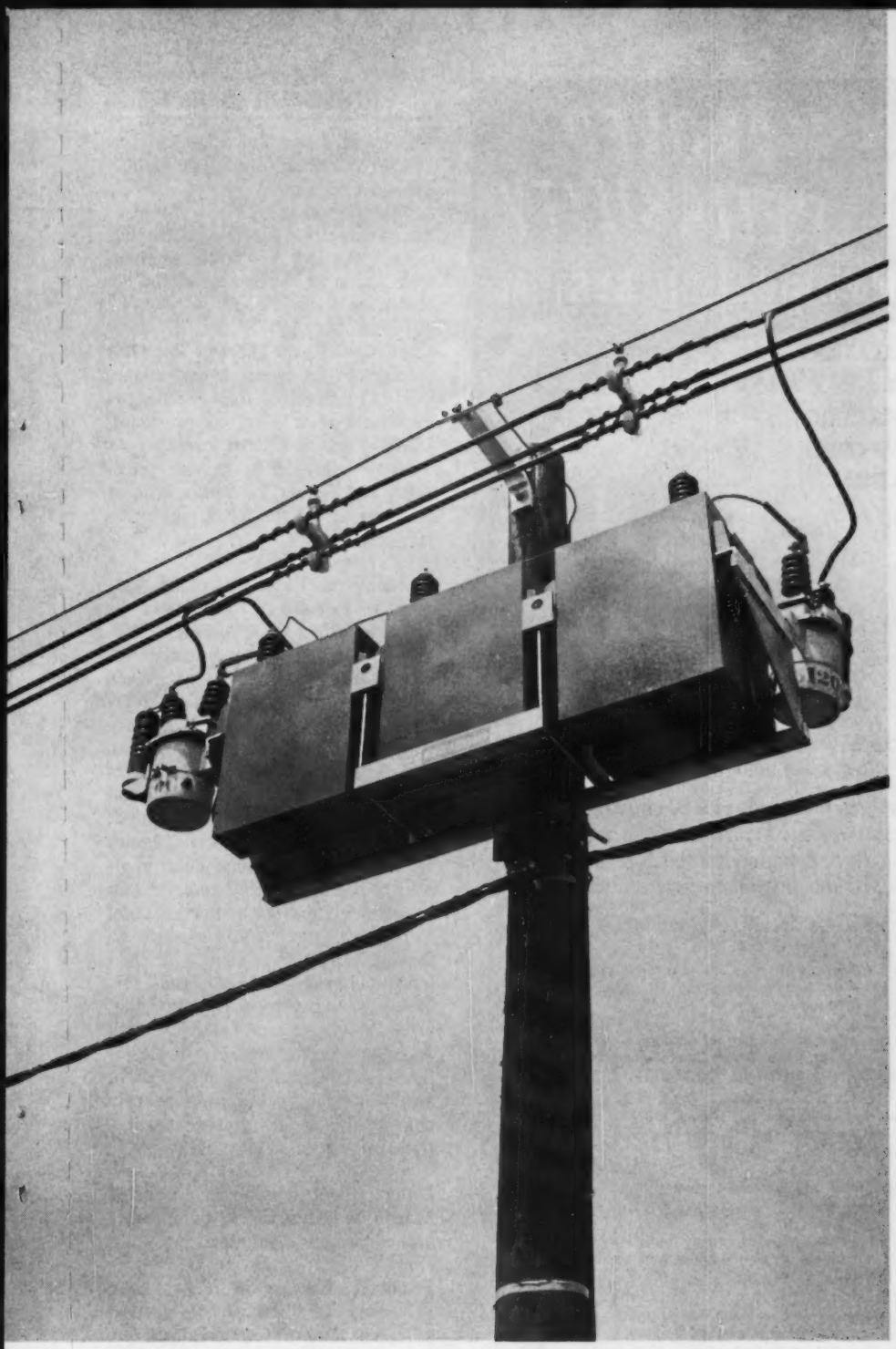
BARTLETT

Bartlett has been with the firm since 1937.

(*More News About People, p* 120)

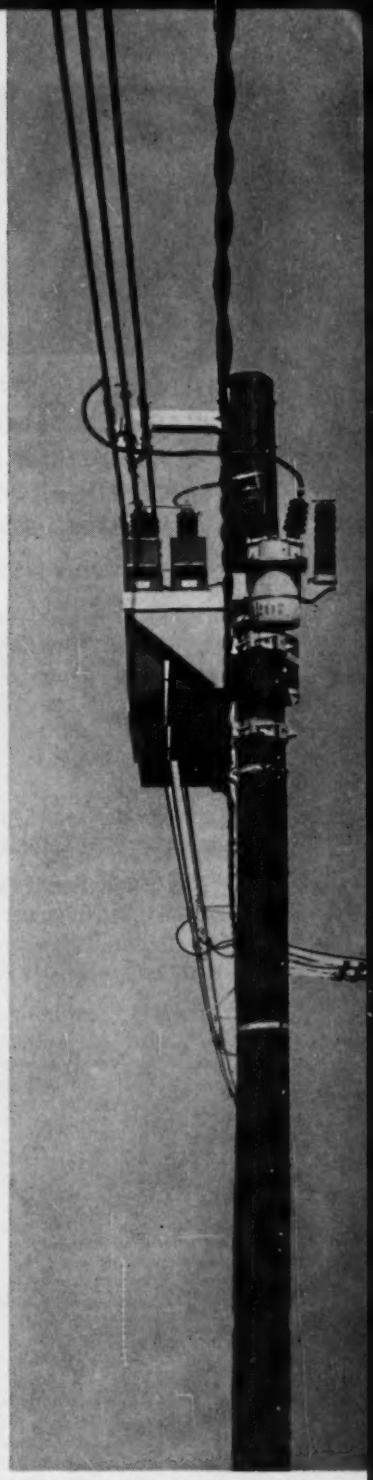
As received.

New Westinghouse Completely Self-Protected Autotrol saves more than $100 in installation costs— eliminates pole top clutter



90-minutes later.

J-69004



Slim silhouette, no pole top clutter.

This test installation on the above 600 KVAR, 13.8 KV Autotrol was made in less than 90-minutes by Public Service Electric and Gas Company; Newark, New Jersey.

This new Westinghouse Completely Self-Protected Autotrol® is delivered as a Complete Single Package. In addition to capacitor units, oil switches and junction box, the new Westinghouse CSP Autotrol has lightning arresters and fuse protection mounted directly on the switches. The cost of installing three arresters and three cutouts is eliminated, also the cost of the cross arm needed to hold them. Therefore, this compact design, which requires less pole space, may mean the difference between using an existing pole and installing a new, taller one. Just hoist up the Autotrol, anchor it to the pole, fasten three leads and it's on the line.

For complete information on this Westinghouse exclusive . . . call your Westinghouse Sales Engineer. Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. You can be sure . . . if it's Westinghouse.

(trademark)

Westinghouse

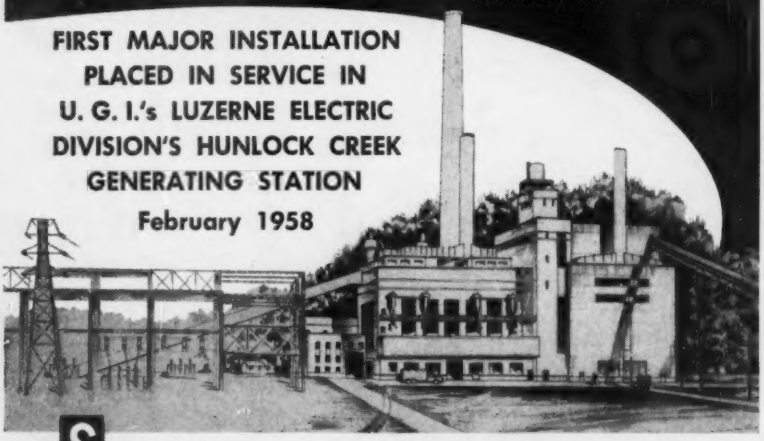
*

GTC PROVED RELIABILITY

IN-PLANT COMMUNICATION SYSTEM

FIRST MAJOR INSTALLATION PLACED IN SERVICE IN U. G. I.'s LUZERNE ELECTRIC DIVISION'S HUNLOCK CREEK GENERATING STATION

February 1958



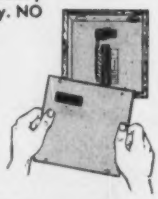
Since that time, the GTC system has delivered constant, uninterrupted service. New plant unit includes extension.

This installation, as well as thousands of GTC units that have been installed in power stations and industrial plants throughout the United States since, have definitely established the superiority and reliability of GTC in industrial voice communications.

Features contributing to GTC's acceptance and reliability are:

1. Provides swift and sure voice communication even in adverse environmental conditions, such as extremes of temperature and noise.

2. All amplifiers are "plug-in" contributing greatly to ease of installation and maintainability. NO CENTRAL EQUIPMENT IS REQUIRED.



3. Long-life transistors and rugged, industrial type components are used throughout. No vacuum tubes or "entertainment" type components are employed.

4. Inconvenience and expense of vacuum tube replacement is eliminated.

5. Design allows expansion of system from "very small" to "very large" by simple addition of units where required.

6. Ultra simple wiring plan (no shielded cables) and unitized equipment with integral terminal facilities make for easy low cost installation.

* GAI-TRONICS TRANSISTORIZED COMMUNICATIONS

Effective • Reliable • Economical

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A SUBSIDIARY OF GILBERT ASSOCIATES, INC.
ENGINEERS AND CONSULTANTS

GTC is extremely flexible in application. Write today for a copy of our completely illustrated, descriptive booklet and name of nearest representative.

PERSONAL BRIEFS

Charles R. Landrigan has retired as executive vice president of Detroit Edison Co.

Massachusetts Electric Co has named **Richard L. Noble** as manager at Athol, succeeding **Hial O. Robinson** who retired.

Mississippi Rural Electric Assn has elected the following: **John Langan,** who is manager of East Mississippi Electric Power Assn, as president; **L. R. Parker,** who is manager of Yazoo Valley EPA, as vice president; and **Stover L. Smith,** who is manager of Dixie EPA, as secretary-treasurer.

Philadelphia Electric Co has appointed **Edward S. Halfmann** as assistant director of research, **William J. Johnson** as engineer in charge of the electrical research section, and **G. Earle Watt** as supervisor of the residential lighting section of the sales department. **Charles E. Nelson,** superintendent of the transmission and distribution engineering division, has retired. Also at Philadelphia Electric, **James H. Harlow** has become chief engineer of the engineering and research department; **Francis J. Berger,** chief mechanical engineer; **Theodore C. Sickles,** engineer in charge of electrical field engineering. **Frank W. Myers** was appointed assistant chief electrical engineer; **Daniel Leitch Jr,** engineer in charge of station design, electrical engineering division; and **Walter E. Scholz,** engineer in charge of station equipment, electrical engineering.

Union Electric Co has boosted **Martin R. Meagher** to engineering and construction engineer.

Frank R. Harrington Jr has been promoted to director of general office services for Toledo Edison Co.

Minnesota Power & Light Co has promoted **Frederic H. Leas** to Aurora district manager, succeeding **Andrew G. Hudy** who retired.

United Engineers & Constructors Inc has appointed **Charles J. Randolph Jr** as engineering manager of the chemical division.

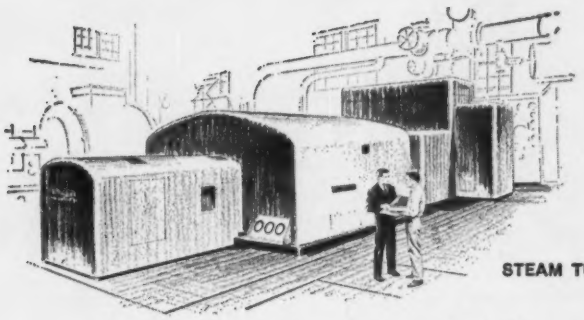
(*More News About People, p* **124**)

DE LAVAL

engineered dependability has helped keep America strong for 60 years

Since 1901, De Laval has helped keep America strong by supplying high-quality, precision-built equipment to almost every industry and service. In refineries . . . power plants . . . steel mills . . . mines . . . waterworks . . . pipelines . . . paper mills . . . the armed forces and the merchant marine, De Laval's engineered dependability has helped strengthen our country's economy and defenses for 60 years.

De Laval Steam Turbine Company, Trenton 2, N. J.



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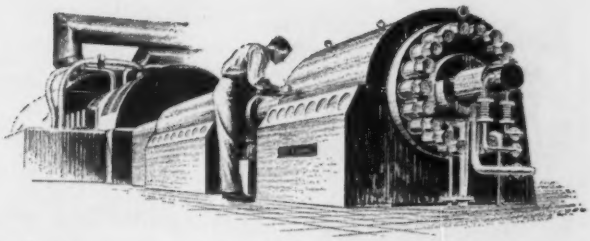

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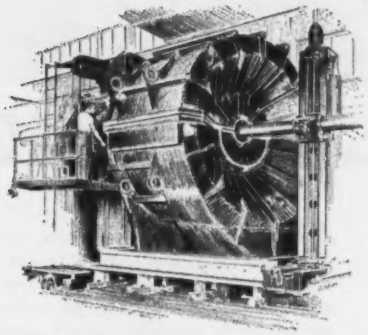

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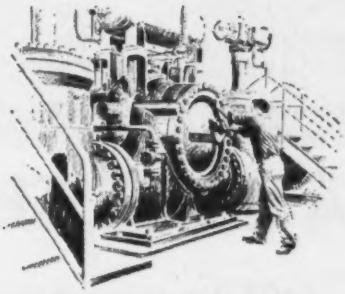

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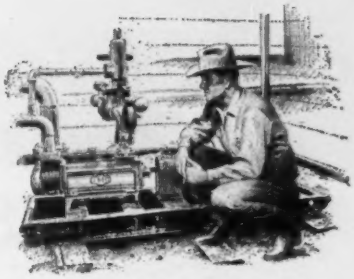

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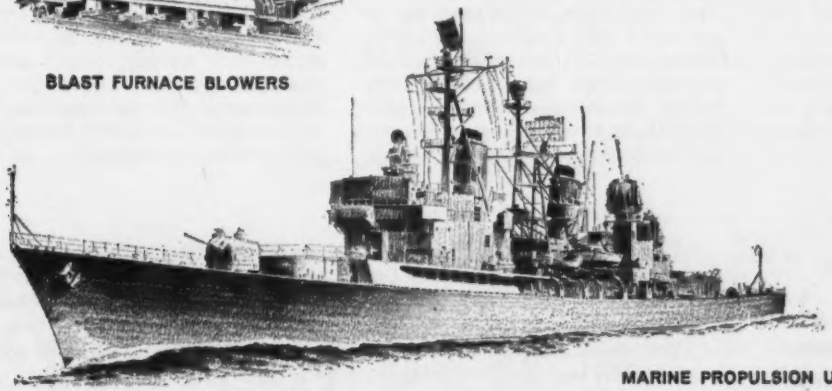

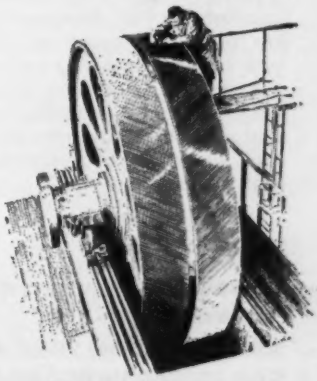

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FACTS ABOUT THE EXCITING

FACT 1—Lark's wheelbase is a comfortable 113". Pioneered by Lark for fleet use 4 years ago (but only now being adapted by competition), the medium wheelbase is considerably longer than the little compacts' and assures a better ride on any surface, plus the "solid" feel so important to the driver.

FACT 2—Lark's over-all length is a sensible 188". Compared to other "new-size" cars, which measure upwards of 196" over-all, '62 Lark's almost total absence of deadweight overhang is an important economy factor. Relatively short length also guarantees easy parking and space-saving storage and shop room.

FACT 3—Lark's front headroom is 36". Front legroom 43.5". This means more comfort for driver and one **or two** front passengers. Wide front doors have no big, knee-knocking doglegs; they do have flush floors (no wells); a man can get in and out of a '62 Lark without knocking his hat, tripping or skinning his shins.

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- ✓ **MORE LEGROOM THAN ANY CAR PRICED UNDER $5,000**
- ✓ **OPERATING ECONOMY PROVED IN OVER 1,000 FLEETS**
- ✓ **ENDURANCE-BUILT BY STUDEBAKER FOR YEARS OF SERVICE**

There are many other Fleet-size '62 Lark **facts** that you, as a fleet operator, should know. These include Lark's new and more efficient rust-proofing, its 12 new noise-suppressors, exclusive front—**and rear**—standard seat belt anchorages and other Lark economy, safety and comfort advances.

You should also know about the fleet records Lark has made in economy, long life, high trade-in value, low maintenance costs and freedom from frequent repair and adjustment necessity.

For complete information, specifications, a full list of available options and a report on Lark's suitability for **your particular** type of fleet or fleets, fill out, clip and mail the coupon. **When you balance your books, you might be very glad that you did!**

NEW '62 *FLEET-SIZE* LARK

FACT 4—Lark's rear legroom is 49". Only the biggest cars, like Cadillac, have more rear legroom than Lark. Rear seat passengers can stretch their legs and really relax. Same flush floors and wide doors as up front, make getting in and out easy. Redesigned trunk roomier than ever, has low-cut opening for easy loading.

FACT 5—Lark's new ladder-type frame is 20% stronger. Rigidly bolted to the heavy gauge steel frame is Lark's solid, welded steel body. This construction is the safest known and the easiest, fastest and least costly to repair after crash damage. Bolted-on fenders, easy to replace—an unskilled laborer can do it in minutes.

FACT 6—Lark offers widest power choices. Lark's standard Six is 112 HP. You also have 4 choices of V-8 engines, from 180 to 225 HP. Four transmissions — including gas-saving overdrive — and six rear axle ratio choices (the latter at no extra cost), make it possible to power-match the '62 Lark to every specific fleet need.

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- Will not dry out or disintegrate in the can!
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ESTABLISHED 1894
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(*Continued from page* 120)

General Electric has made the following appointments: **Robert S. Baker** as manager of the Huntsville, Ala., computer center for the computer department; **Dabney Tunis,** manager-advertising and sales promotion; and **Richard O. Parrish,** specialist-A&SP.

Allis-Chalmers Manufacturing Co has appointed **Will Mitchell Jr** as research division director.

Elbert G. Bellows has become assistant to the presidents of De Laval Separator Co and De Laval Steam Turbine Co.

Patrick L. McManus has been made general manager of Worthington Corp's standard pump division at East Orange, N. J.

Richard H. Wilcox has stepped into the position of assistant to the president of P. R. Mallory & Co, Inc. His activities will include administrative assignments in manufacturing, marketing and finance.

Kenneth Benson of Ohio Brass Co will become district manager in western Pennsylvania upon retirement of **Stanley L. Walworth.**

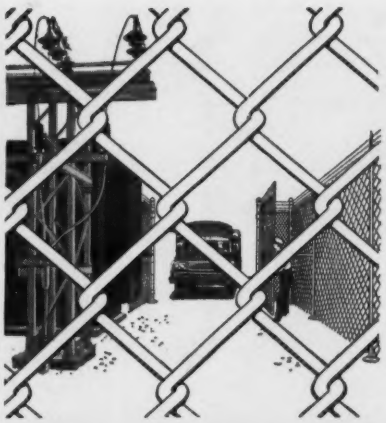
Radio Corp of America has appointed **James Lee Owings** as engineering manager for the data communications and custom projects department of the electronic data processing division. **Dr Jan A. Rajchman** became director of the computer research laboratory at RCA's David Sarnoff Research Center.

James A. Thomson has been named Salt Lake City branch manager for National Electric division of H. K. Porter Co, Inc. He succeeded **John Longden** who resigned.

New advertising manager for Fuller Co is **John M. Sheehan Jr.**

Donald M. Brown has stepped into the post of product manager for Electric Autolite Co's electrical products group.

International Business Machines Corp has promoted **Samuel B. Korin** to manufacturing equipment development manager.



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3. INSTALLATION is important, too. A fence can be no better than the quality of its erection. The Page Fence Member in your locality is trained, experienced, responsible, and interested in your satisfaction.

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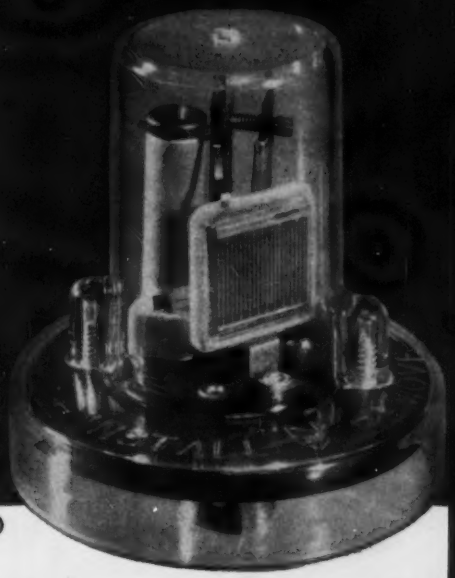

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Now—Precision withstands any lightning surge better

Compare this *new* Precision Omega with any other photocontrol at any price. You can *see* the engineering distinctions that make Precision's 2-component circuit (plus lightning arrester) the exclusive choice for lightning-proof multiple lighting in Key West, Florida.

Lightning surge — low- or high-voltage — can't phase the operational dependability of Precision "Omega" with its oversize lightning arrester — the most effective ever used in street lighting controls.

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Add these features together and you can understand why Precision 2-component photocontrols are used on more installations than any other single circuitry. All sound reasons why we insist that Precision's new Omega is *the* best choice for utility buyers who think photocontrols should last forever under any conditions.

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PUA of Virginias Elects Lyon

Charles D. Lyon (second from right), vice president of Potomac Edison Co, receives the symbol of the presidency of Public Utilities Association of the Virginias at the association's recent meeting at White Sulphur Springs, W. Va. The gavel is presented by Eric C. Summers, vice president, Monongahela Power Co, whom Lyon succeeds. Miles Cary, left, is the association's new second vice president, as well as vice president, Virginia Electric & Power Co. G. South Dunn, director of public relations, Appalachian Power Co, was elected first vice president. Meeting speakers stressed the role of utilities in area development projects.

Flicker Controlled at Stellarator

(*Continued from page* 68)

two 2,500-MCM copper, rubber-insulated, shielded 5-kv cables per phase.

All other loads were split between two sections of 4.16-kv switchgear, with the 22 Mva divided equally. These buses also are rated 2,000 amp but 250-Mva capacity breakers were used for serving these loads. Two 2,000-MCM copper cables per phase feed each bus.

The emergency 4.16-kv bus, designated Q4, has all essential services connected to it. Normal supply to the accelerator is through a connection from the bus to a 5/6.25-Mva, 4.16-26-kv transformer and the 26-kv tie line. The 26-kv utility service at the accelerator is normally open, but closes automatically on failure of the 132-kv system supply. The normal supply breaker for emergency bus Q4 opens to isolate this emergency bus from the rest of the system before the 26-kv connection is closed. Automatic transfer to emergency power takes about 2 sec.

Reliability is further enhanced by the use of a 350-kw diesel-generator. Whenever the 132-kv power source fails and the 26-kv source takes over, the engine is started. If power is off for 10 sec, the 480-v transfer switchgear connects the essential equipment loads to the generator.

For additional continuity of service, the 26-kv standby service is opened and the 132-kv regular service is closed in when voltage is restored to the incoming line. This can happen only if the cause of the initial outage was external to the project system. If the 132-kv breaker was opened originally by a fault on the 132-kv bus, in the transformer, or in cables supplying the 4.16-kv buses, a retransfer to normal source is blocked.

Automatic switching of the 132-kv and the 26-kv breakers is accomplished by low-current dc pilot wire type relays connected by a multiple pair telephone type direct-burial cable between the stations. One pair is used for voice communication for maintenance operation.

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Position available as manager for Rural Electrification Administration electric power system in beautiful scenic area of southern Utah consisting of 604 miles of distribution line, 136 miles of transmission line and two hydroelectric plants. Good hunting and living conditions in 5000 population community with fine schools and other facilities. Substantial opportunity for qualified applicant having administrative, management and extensive operating experience related to electric power system. Send full experience resume and request for application form to Garkane Power Association, Attention Selection Committee, Richfield, Utah.

Electrical Engineer—Experienced in electric design of power plants and/or electric transmission and distribution line. Attractive position. Submit resume to Pfeifer and Shultz, Engineers, 700 Wesley Temple Building, Minneapolis 3, Minnesota.

Transmission Engineer — Graduate engineer with a minimum of five years experience in design of electrical transmission and substations. Knowledge of carrier and supervisory desirable. Excellent opportunity for advancement in a rapidly expanding organization in the southwest. Liberal fringe benefits. Submit resume, including education, experience, personal qualifications and salary requirements to P-7546, Electrical World.

Relay Technician—With a minimum of five years in protective relay work including test, calibration and maintenance. Knowledge of carrier and supervisory desirable. Excellent opportunity for advancement in a rapidly expanding organization in the southwest. Liberal fringe benefits. Send resume, including education, experience, personal qualifications and salary requirements to P-7551, Electrical World.

Operator in small Diesel Power Plant preferably over 50—Write Electric Corp., Fishers Island, giving references and experience.

SELLING OPPORTUNITY WANTED

Electrical Engineer with vast experience in the industrial and mechanical fields wishes contact manufacturers willing to do business in Spain. RA-7565, Electrical World.

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Minimum 5 years experience designing power and lighting for industrial, chemical and metallurgical plants required.

Must be capable of handling design and related problems from inception to final completion.

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News Scope

CONTROVERSY'S END—The last corporate vestige of the Dixon-Yates controversy will fade shortly now that the Securities & Exchange Commission has authorized Middle South Utilities, Inc, and Southern Co to pay $1,340,000 to the creditors of Mississippi Valley Generating Co, the company they organized to feed power into the Tennessee Valley Authority system. Prior to cancellation of the contract, MVG owed $1,868,000; it incurred $572-,000 in expenses fighting the case. The company's total assets were $1.1 million. The SEC ruling okays payment of the balance by Middle South and Southern. MVG will then be dissolved.

SEEK PURCHASE—Eugene (Ore.) Water & Electric Board has authorized its superintendent to negotiate with Pacific Power & Light Co or the Eugene municipal system to buy Pacific P&L facilities serving suburban and rural areas around Eugene.

COOL A-PLANT—A nuclear power plant 700 miles from the South Pole came a step closer to realization recently when the Atomic Energy Commission selected, as a basis for contract negotiation, a proposal of Alco Products Inc to build and install the plant. To be assembled by Naval Construction Battalion "Seabees" at the Antarctic Byrd Station and operated by the Navy after an AEC-conducted testing program, the plant is the second such authorized in 1960 for the South Pole region.

DEDICATION — Public Service Electric & Gas Co dedicated its $110-million, 640-Mw Mercer electric generating station last week. Located on the Delaware River south of Trenton, N. J., it is Public Service's fourth new generating station built since the end of World War II and the utility's largest. Each of the two 320-Mw turbine generators consists of two shafts, rotating at 3,600 rpm. The boilers produce 1,100F and 2,060,000 lb of steam per hr at 2,400 psi.

ALTERS ORDER—Federal Power Commission recently modified its July 10 order granting a hydropower license to the city of Seattle for its contested boundary project on the Pend Oreille River, Wash. The new ruling requires Seattle to reserve 48,000 kw of boundary power for use by Pend Oreille County PUD. Meanwhile, the FPC has received a license application from Harrison County Rural Electric Membership Corp (Corydon, Ind.) to build and operate a 54-Mw hydro plant at the Corps of Engineers' lock and dam, to be built on the Ohio River upstream from Cannelton, Ind.

FUEL LOADING NEAR—Fuel loading of No. 1 reactor at Britain's Hinkley Point is scheduled for February. Loading had been delayed ten months in order to incorporate AEA's revised nuclear data, largely effecting the graphite core. A spokesman said the revised program enabled the consortia to uprate the performance of the station and a 25-year life is now expected.

GO-AHEAD—The Army Department and Budget Bureau have given a helping hand to a Congressional bill to permit construction of Duke Power Co's $280-million steam generating plant at Middleton Shoals on the Savannah River. They declared that the plant would not interfere with future planned development of the river and would not be adverse to government interest. The bill is sponsored by South Carolina.

WORK PROGRESSES — Main work on construction of a boiling-water, 12.5-Mw reactor, known as Japan Power Demonstration Reactor, is underway. With a November 1962 target date for completion, the $12.2-million nuclear reactor will be used for experiments in atomic power generation and to study development of nuclear-powered vessels. Preliminary work, begun last October, was completed in August.

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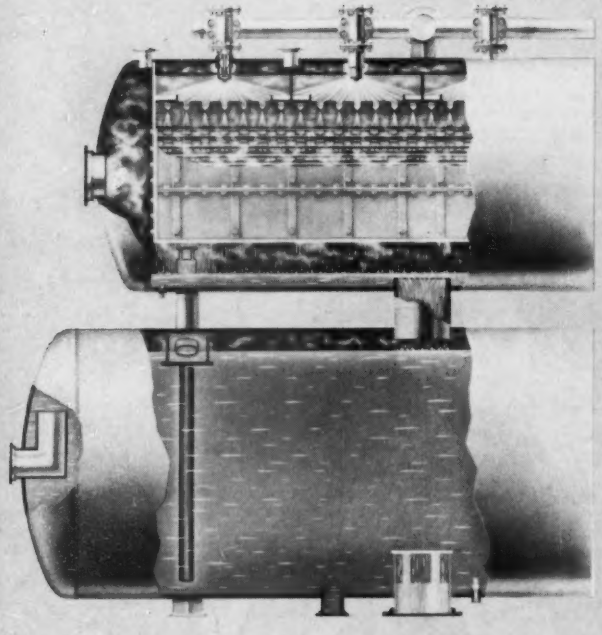
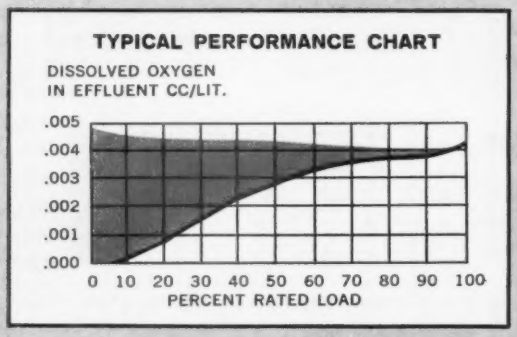
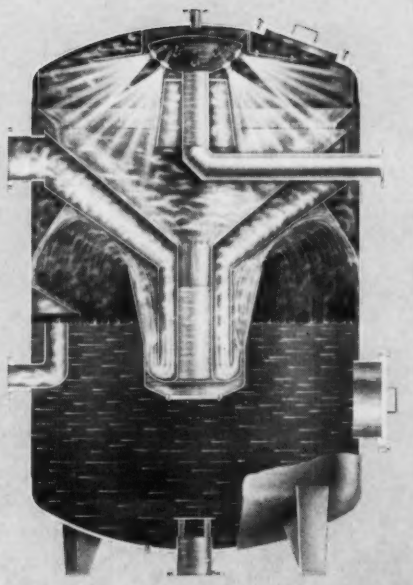
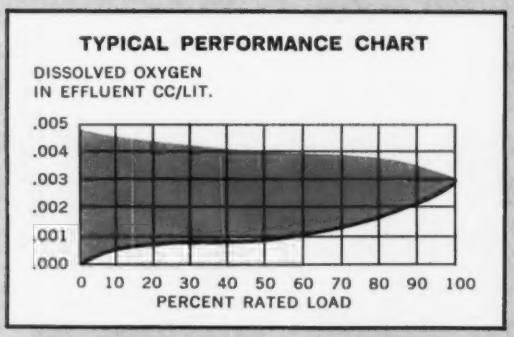




TRAY-TYPE DEAERATOR





STEAM JET DEAERATOR

ARE YOU IN THE "RED"?

Look at the "red" area of the two charts shown here. Virtually every deaerator's performance under partial load falls somewhere in this area. You should consider this performance critically in evaluating new deaerator quotations.

Why is this area important? As you know, many electric generating plants that start up as full load base plants will eventually be switched to part-load peaking plants. At that time all components will be under partial loads. They should, therefore, also have been evaluated for partial load performance when purchased.

Why is this so important for deaerators? Many makes of deaerators that perform comparably at full loads separate widely in partial load performance. In many, performance stays level or actually becomes poorer under partial load . . . so a performance curve falls high in the red areas, above.

Now note the performance of both Worthington deaerator designs. Both types meet the most exacting full-load performance requirement. Then, as load falls off, performance actually improves sharply. We believe you'll find no other deaerator performs so well in this partial load area.

Why are the Worthington deaerators better? Both types have a true counter flow design that is effective at all flow rates. Even at minimum flow the spray valves atomize fully. And the ideal distribution and flow direction is maintained by a more efficient baffle pattern.

Worthington deaerator designs result from unmatched experience in the fluid-handling group of power plant components. To draw on this experience—or for a deaerator quotation—contact your nearest Worthington District Office. Or write Worthington Corporation, Section 45-22, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

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